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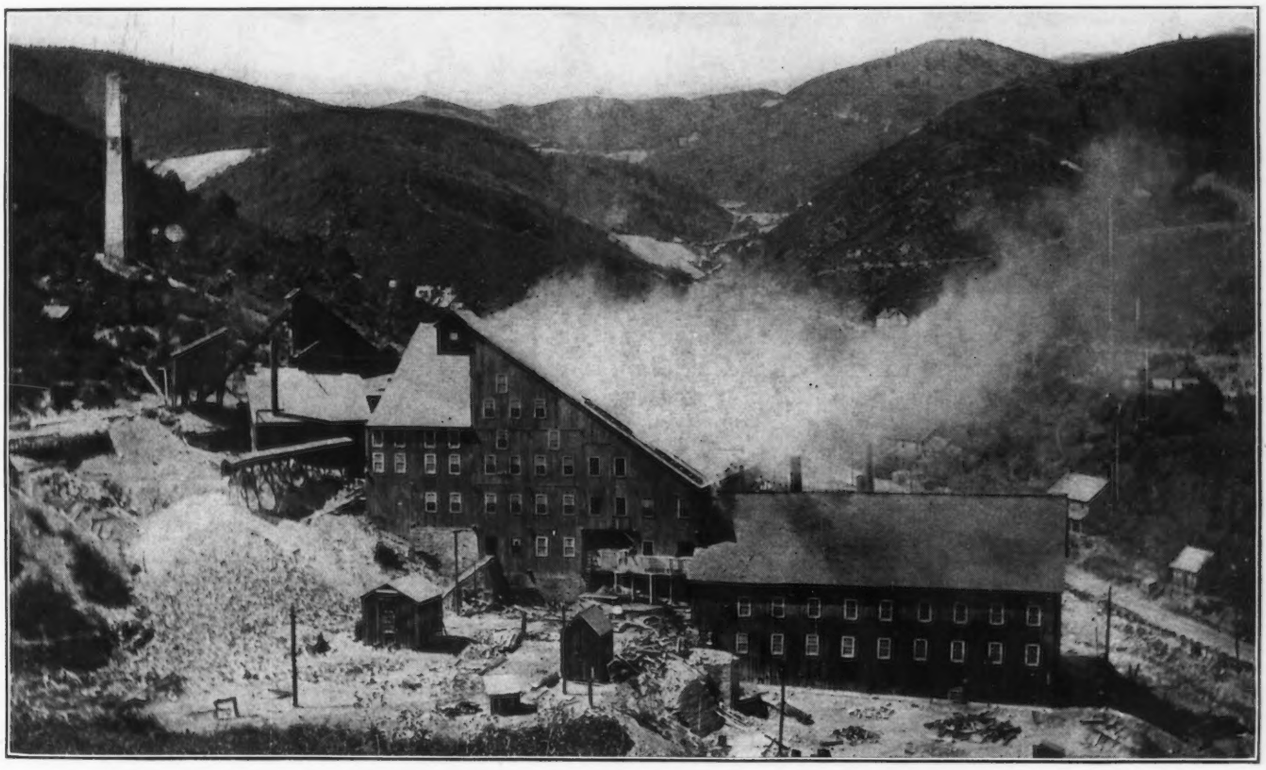
Chloridizing Blast Roasting and Leaching--I

By Glenn A. Keep*

SYNOPSIS—Operating details of the new chloridizing-leaching practice at the Mines Operating Co.'s mill at Park City, Utah. The development of the Holt-Dern roaster has greatly cheapened the chloridizing of the ores and makes susceptible to this process low-grade complex ores formerly valueless. Tower acids from the roasters form the basis of the leaching solutions which dissolve the metals quickly when ores have been properly chloridized. Mill solutions corrosive of metals and wooden pipe and fittings are required; the suction fans have concrete-covered blades.

The subject matter of this article was derived from experience in operation of the Mines Operating Co.'s mill at Park City, Utah, treating the low-grade refractory stope fillings of the old Ontario mine. These fillings contain silver, copper, gold, lead and zinc in the forms of oxides, carbonates, chlorides and sulphides. The gangue is quartzite in the west part of the mine, and porphyry in the east part, and in some places contains 2 to 5% CaO.



Mines Operating Co.'s Mill at Park City, Utah

Chloridizing Blast Roasting

Chloridizing blast roasting is accomplished by combustion of fuel, intimately mixed with the ore and salt, by forcing a blast of air through a mixture of ore, fuel and salt. The mixture must be damp, containing from 5 to 10% water, depending upon the ore and size of crushing. This moisture is driven off before reaching the roasting zone, making the ore above very damp, almost wet. The moisture acts as a blanket, confining practically all the heat of combustion to and beneath the roasting zone. A hard, dry cake about 1 in. thick forms directly on top of the red-hot ore, which also acts as a blanket. The forma-

*Park City, Utah.

tion of this cake is due to the cementing action of the salt after the moisture is driven from the mixture. However, as the roasting zone progresses upward the salt in this cake is decomposed, and consequently the roasted ore is loose and open, but does not, as a rule, fall apart unless disturbed. If excess moisture is used the resulting roast may be hard, although not in the least sintered.

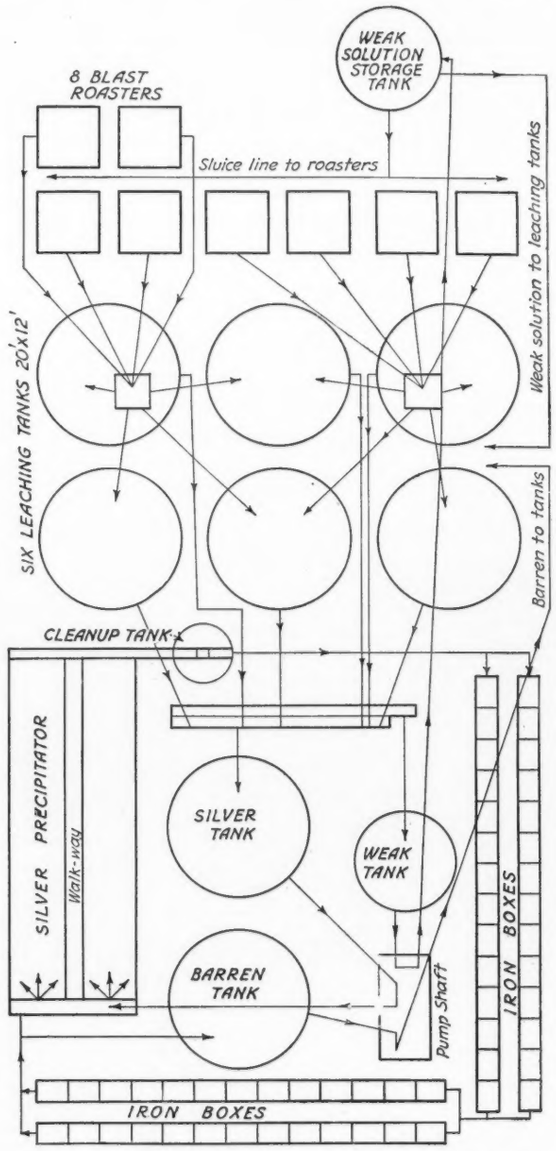
The commending points in chloridizing blast roasting are extreme low cost of roasting, the uniform, well chloridized product, and the ease of leaching this roasted product, although the ore before roasting be of a slimy nature. The amount of fuel required is surprisingly low, ranging from 2 to 3% of coal dust when no fuel is present in the ore. The coal dust used by the Mines Operating Co. is screenings from slack coal and costs 25c. per ton, f.o.b. cars at the coal mine. If pyrite alone were used for fuel, from 6 to 12% would be required. A heavy crude oil makes a good fuel where a low temperature is desired, there being no danger of too hot a temperature when using this fuel, as a high temperature will volatilize the oil ahead of the roasting zone. From 2 to 3% crude oil is sufficient to give a red-hot roast. In blast roasting, the heat is well conserved as the cold air first passes through the hot roasted ore where it is preheated, then into the roasting zone from which the highly heated gases pass into the damp unroasted ore above, thus heating the ore, and then into the flue at a temperature so low that one can put his hand into the flue without any discomfort.

The gases, when the ore contains sulphides, are extremely corrosive to iron. They contain water vapor, chlorine, sulphur dioxide, hydrochloric and sulphuric acids. Concrete is only attacked slowly by the fumes and concrete flues will last for years. Passing the fumes through mill solution or water forms a "tower acid" which contains chlorine, sulphur dioxide, sulphuric and hydrochloric acids. The tower acid smells strongly of sulphur-dioxide gas which is given off for several days if allowed to stand. The amount or strength of acid thus formed depends upon the amount of salt used in the roast to some extent, but mostly upon the amount of sulphides present in the mix. If the ore is not of a limestone gangue, 1 to 4% of sulphides as iron pyrite will make enough acid for leaching purposes, even if the ore contains 2 to 3% copper. The gangue of the ore has a great deal to do with the amount of acid produced in the fumes. A limestone gangue or an ore with a small percentage of lime will not produce much acid in the fumes as the acid is neutralized by the lime. Quartz gangues are good acid producers, a blast roast on quartzite and salt producing much hydrochloric acid. Some porphyries are better from the point of acid production than is quartzite.

The Roasted Product Should Be Slightly Cemented but Readily Friable

A damp mix will roast faster than a dry mix with the same amount of coal and at a higher temperature, and also gives a roast in which the particles are cemented together, sometimes forming a hard cake. A dry mix gives a roast in which the particles are loose so the roast readily falls apart. A dry mix would contain from 5 to 7% moisture, depending upon the ore. The mix should contain enough moisture to make the charge more porous than when dry. The finer the crushing the more moisture will be required. The best roast is obtained from a medium mix in which the moisture is such that the resulting roast is slightly cemented but is readily broken up. A high percentage of salt has a tendency to make the roasted product cemented or caked together.

Too much fuel in the mix results in a sinter, which is to be avoided, as the best extraction cannot be obtained upon



Flow Sheet of Mines Operating Co.'s Mill

a sintered product, although if not too badly sintered a fair extraction of silver can be expected, but not of copper.

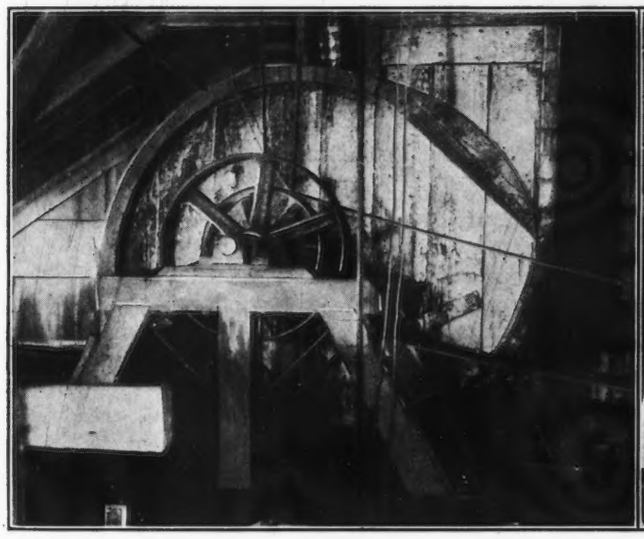
Temperature Limits in Roasting

A low-temperature roast will give better results upon both gold and copper, while silver will stand a temperature up to 800° C. without bad effects. A temperature of 600 to 750° C. is the correct temperature for chloridizing silver in the blast roaster, while a temperature of 500 to 650° C. does good work upon copper. In chloridizing ores high in gold it would be advisable to discharge the hot roasted ore into a cooling bin beneath the roaster. As the gold chlorides are decomposed by the ordinary roasting temperature, cooling the roasted ore slowly will cause the gold to be rechloridized and hence

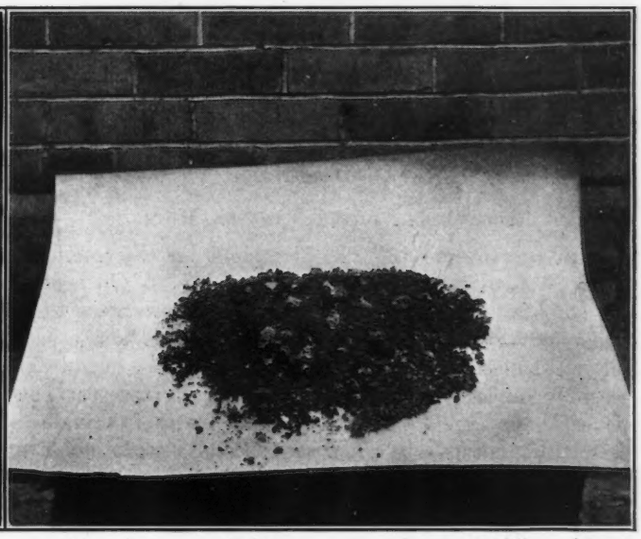
readily soluble. Slow cooling to rechloridize gold is an art which was practiced in the old sodium-thiosulphate processes. However, other means mentioned later are employed to dissolve gold which has not been chloridized in the roast.

As the roasting zone is kept covered with unroasted damp ore there are no volatilization losses. Assays of material taken from the fans and flues at different times have never been greater than 2 oz. of silver and no gold. For the same reason there are no dust losses. Tests upon fumes from roasting copper ores show there is no volatilization of copper.

All ore going to the leaching tanks should be well roasted, as unroasted or partially roasted ore will usually give trouble in the leaching process. Ore which has not been heated to a red-hot temperature will not be leachable even if this ore has been on top of an 8- or 10-ft. column of roasting ore and had all the fumes from the roast pass through the ore. Such green ore is only slightly chloridized, and extraction will be poor. Green ore also consumes much acid, especially if it contains a little lime. Unroasted ore contains the original slimes in the ore and



SUCTION FAN WITH CONCRETE-COVERED BLADES



SOME 20-MESH ORE AFTER ROASTING

will give trouble in leaching by retarding or stopping the flow of solution through the leaching tanks. Partly decomposed pyrite in poorly roasted ore will cause reprecipitation of metals, due to generation of hydrogen sulphide gas by action of acid upon the partially decomposed pyrite. The construction of the Holt-Dern roaster is such that there is no opportunity for any unroasted or partially roasted ore to be discharged from the roaster, and hence no troubles of the above type would be encountered where this type of roaster is employed.

LIME HINDERS, BUT PYRITE AND MANGANESE DIOXIDE AID CHLORIDIZATION

All copper and silver ores are amenable to chloridizing leaching, except those having a limestone gangue or containing an excess of lime. In roasting an ore containing a small amount of limestone, pyrite must be used in the mix. The action of the pyrite is to decompose and neutralize the lime in the roasting ore so that there will not be an excess consumption of acid in the leaching of such an ore. Ores with limestone gangue require slightly more fuel than other gangues. Good results can be obtained upon ores containing a small amount of lime, but as a rule, limy ores are not easily chloridized.

Pyrite in the mix also aids in chloridization by forming sulphates, which in turn combine with the salt, forming sodium sulphate and thus liberate chlorine, which combines with metals making the chlorides, the object of the roast.

Manganese dioxide also aids in chloridization by reacting with salt and acid and with the acid alone to form chlorine, which becomes available for chloridization. This chlorine might remain unavailable as undecomposed salt or pass off in the fumes as hydrochloric-acid gas if not acted upon by manganese dioxide.

Although it has been pointed out that both manganese and pyrite are aids in chloridization, it does not follow that they are a necessity for chloridizing in the blast roast. The importance of pyrite is much greater than manganese, and most ores will show a slightly better extraction upon the addition of 1 to 2% of pyrite in the mix. This is especially true in case of copper ores where more pyrite is required for the best results than for silver. Some authorities say there should be as much sulphur present as copper to chloridize copper ores, but experience with blast roasting indicates that to get the maximum extraction there should be about twice as much sulphur present as there is copper. For example, a 1% copper ore should have 4% of pyrite in the roasting mixture, more pyrite doing no harm. However, good results can be expected with 1 to 2% pyrite present in the mixture.

An important item in chloridizing blast roasting is the fact that the "slimes" in an ore are agglomerated, that is, one particle of "slime" adheres to another forming a small porous mass. This action results in making an easily leached product from an ore which before roasting was totally unleachable. Ore as fine as 80 mesh has been successfully leached due to this agglomerating action. However, such fine crushing has been neither desired nor necessary for good results upon any of the many different ores which have been tested.

A Deep Bed and Time Essential for Good Chloridization

In blast roasting, good chloridization can be obtained upon fairly coarse ore when there is a bed of red-hot ore from 2 to 4 ft. deep and where the ore is under the chloridizing conditions for 3 to 5 hr. For instance, on ½-in. material roasted under the above conditions, an extraction of 80% has been obtained, while the same mix roasted in a small experimental roaster would show only 40 to 50% extraction. In other words, as good chloridization cannot be obtained in roasting a thin bed as in roasting a deep red-hot mass kept under chloridizing conditions for a long period of time.

The amount of crushing required for good work will, of course, vary with different ores, but it is safe to say that few ores will require finer crushing than 6-mesh, while a great majority both of copper and silver ores need not be crushed finer than ¼ in. to obtain the best results where roasting is carried on under the above conditions. This rather sweeping statement is made after conducting tests upon many different ores, and may be partially explained by the fact that in the roasting process, the larger particles are shattered and rendered more or less porous. This shattering is, on some ores, so marked that after roasting, the larger particles can be crushed between the thumb and finger. Where roasting is carried on in a thin bed and when the roasting and chloridizing conditions are not maintained for considerable length of time, finer crushing and usually more salt are required to obtain the same degree of chloridization.

Recoveries of the Various Metals

With proper roasting and treatment an extraction of 85 to 95% of the silver and 90 to 98% of the copper can be obtained upon most ores. The extraction of gold seems to vary more with different ores, but many ores will yield more than 90% of the gold. What can be expected upon lead is not known with any certainty. The Mines Operating Co., in treating an ore so low in lead that it did not pay to make any special attempt to save lead, nevertheless cleaned up several tons of lead from the "iron boxes" each month. At present nothing of note is known concerning zinc and no saving could be expected.

The Mines Operating roasters, which are built of reinforced concrete, are 10 ft. square and can be charged to a depth of 10 ft. or less. The ore rests upon 2x2-in. wooden grates spaced ¾ in. apart. These wooden grates are supported by timber framework. Air is admitted by an 18-in. air flue to the space between the grates and the bottom. The top of the roaster is covered with pieces of sheet steel which are supported by grizzlies resting upon 5-in. T-irons set in the concrete. The fumes are taken off at one side of the roaster near the top by a concrete flue. This flue is connected to two suction fans which handle the gases from eight roasters.

Starting a Roast

Resting directly upon the grates is a 4- to 6-in. bed composed of roasted ore mixed with 2- to 4-in. rocks. In starting a new roast, about 75 lb. of coal dust, which has been moistened with a cheap grade of coal oil, is spread in a thin layer evenly over the bed. The coal is ignited and a blast of air turned into the roaster. The coal is allowed to burn fiercely for 2 or 3 min. until the layer of coal becomes a sheet of red-hot coke. Then about 1½ tons of the mix of ore, salt and coal are shoveled into the roaster through the front discharge door directly upon the glowing coke. This ore is immediately ignited and is allowed to roast for a few minutes until nearly all the ore becomes red hot. The blast of air is then shut off and about 2 ft. of ore is charged into the roaster through the top, direct from the ore-bin chutes. The air is quickly turned into the roaster again and roasting continued for about 1 hr. Again the air is shut off and the charging of the roaster to the desired depth is completed.

After roasting, the ore which is still red hot is sluiced by mill solution from the roaster to the leaching tanks. The sluicing is accomplished by means of a 2½-in. rubber-covered and rubber-lined hose, using hard-wood (maple or hickory) nozzles. The flow of solution is controlled by an iron clamp on the hose. On account of violent explosions due to the red-hot ore, the nozzle is attached by a wire to the center of the discharge door and the direction of the solution stream is controlled by a man at one side using a 10-ft. pole.

As is quite evident, the capacity of these roasters depends largely upon the ease and quickness with which they can be discharged, or in other words, upon the hardness of the roasted ore. The time of one complete cycle of operation, starting, roasting and discharging, is about 24 hr. There are five roaster men in each shift, two men being employed in discharging roasters and three men in loosening the beds, starting, and loading the roasters.

Cost of Chloridizing, 93.3c. per Ton

The average cost of ore roasted during the six months ended Aug. 31, 1914, in the above described roasters, was 93.3c. per ton. This cost includes the maintenance and upkeep on the roasters, flues, suction fans, solution lines and launders, and is divided as follows: Labor, $0.40; salt, $0.32; supplies, $0.082; power, $0.061; coal, $0.059; and pyrite, $0.011 per ton of ore roasted.

The amount of salt used in the mix was 7 to 8%. The amount of coal dust varied from 2.4% when pyrite was used to 3% when no pyrite was added. The mix was run rather dry in order to keep the roasts as soft as possible. Air is furnished by one Connersville rotary blower requiring 42 hp., about ¼ hp. per ton of ore roasted. The pressure varies from ⅜ to ¾ lb. per sq.in., depending upon the number of roasters taking air at one time. At first, charges of ore 10 ft. deep were roasted, but it was found that the speed of roasting was considerably diminished in the top 3 or 4 ft., due to lack of air pressure. Hence 6 to 7 ft. was adopted as the most economical depth of ore charge to be roasted. Because of slowing down the speed of roasting due to the lack of air capacity, it did not pay to crush finer than ½ in., although mill tests upon ¼-in. ore showed an increased extraction of 12% over the 78% extraction which was the average extraction upon silver for the last year. The diminished rate of roasting caused by finer crushing was mostly due to roasting a dry mix. It was not practical to roast a damp mix which is much more porous and roasts faster than a dry mix, because a damp mix gives a harder roasted product. The capacity of the roasters would then be curtailed due to increased difficulty in discharging the roasted ore.

At the beginning of operations, it was supposed that the roasted ore could be economically cooled by a blast of air. In fact, it was thought that the ore would be

cooled by the air blast nearly as fast as it was roasted. Experience in roasting a deep bed of ore soon disproved these assumptions. It was discovered that, after a 10-ft. bed of ore had been completely roasted, the top 6 to 7 ft. of ore was still red hot. Such a red-hot mass of chloridized ore will remain red hot for several days even when a blast of air is passing through it. Experience has demonstrated that roasters will not die out when the air has been shut off for 48 hr., but upon renewing the air blast, roasting will continue as if there had been no interruption. Due to the wire reinforcement breaking, the concrete roasters cracked badly. Also, there is much wear on the sides and back of the roasters on account of mechanical abrasion caused by the sluicing stream. It has, therefore, been necessary to reline these worn places every few months.

Roasting Costs Much Reduced by the Holt-Dern Roaster

The type of roaster which has just been described was designed to do the work only until a more substantial and more economical roaster could be built and thoroughly tested out under actual mill conditions. Such a roaster, known as the Holt-Dern roaster, has been in successful operation for nine months at the Mines Operating mill. Only mention of this roaster will be made here, as it is the intention of Mr. Holt to publish a detailed description of the Holt-Dern roaster in a short time.

An estimate of the cost of operating Holt-Dern chloridizing blast roasters for a 150-ton plant is: Labor, three men at $3.50, $0.07 per ton; repairs, $0.01; power, $0.049; coal dust, 3%, $0.05; total, $0.179 per ton. To these roaster costs must be added the cost of salt; the salt used would amount to 6 or 8% where a 24° Bé. salt-acid leach is employed for extracting silver, copper and lead. In case of a copper ore requiring only a straight weak-acid leach, or in case of an ore which is to be treated with cyanide after a chloridizing roast, 2 to 5% salt will probably be sufficient. An example of the latter class of ore is one which requires a chloridizing roast to obtain a good extraction by cyanidization, and which contains enough lime to make salt-acid leaching prohibitive on account of high acid consumption. As the Holt-Dern roaster only requires the attention of one man for 5 to 10 min. every 1½ to 2 hr., in a 50-ton plant containing one roaster this man could also attend the leaching department so that the above cost would only be slightly increased for the smaller mill.

(To be concluded)

Right to Mine Ore Under Lake Bed

By A. L. H. Street*

One who owns land in Minnesota bordering upon navigable or public waters has a qualified right to remove ore between high- and low-water mark, according to a recent decision of the Minnesota Supreme Court announced in the case of State vs. Korrer, 148 *Northwestern Reporter*, 617. The court said: "While the title of a riparian owner in navigable or public waters extends to ordinary low-water mark, his title is not absolute except to ordinary high-water mark. As to the intervening space his title is limited or qualified by the right of the public to use the same for purpose of navigation or other public purpose."

*Attorney, St. Paul, Minn.

European Iron and Steel in 1914

The first half of 1914 was no better for the iron and steel trades in Europe than in America, and our chief rivals—Germany and Great Britain—did not make a good showing. The war has been a further drawback of a formidable character. It is of interest to see what actual production is and has been under the stress of the present time. The German Iron & Steel Union keeps up its regular reports, notwithstanding the disturbed conditions.

From the other important iron producers in Europe no returns are available. The industry in France is much disturbed, but a large part of its production is going on. In Austria-Hungary the iron industry was in a bad way early in the year and several of the large companies were embarrassed financially; undoubtedly their situation is much worse now. In Belgium, of course, the iron industry is prostrated for the time.

German Pig Iron

The make of pig iron in Germany shows some improvement over the early months of the war, the total for October, as reported by the German Iron & Steel Union being 729,841 metric tons, as compared with 580,087 tons in September, and 1,653,051 tons in October, 1913. All districts show decreases from last year, the greater ones being in the South German and the Lorraine-Luxemburg divisions. For the 10 months ended Oct. 31 the total make of pig iron was, in metric tons:

	1913	1914	Changes
Foundry iron	3,054,418	2,248,496	D. 805,922
Forge iron	416,304	317,718	D. 98,586
Steel pig	2,156,771	1,745,266	D. 411,505
Bessemer pig	301,746	227,226	D. 80,520
Thomas (basic) pig	10,179,698	8,214,023	D.1,965,675
Total	16,108,937	12,746,729	D.3,362,208

The total decrease in 1914 was 20.9%, which is less than might have been expected under all the conditions. Part of the German ore supply has been cut off by the war operations, notably that from the Lorraine Minette district. Of the ore imports those from Spain and Russia have been stopped, but probably those from Sweden have continued to some extent.

German Steel

Steel production in Germany which was 1,627,345 metric tons in July, fell off to 566,822 tons in August, but increased to 900,201 tons in October. No comparisons can be made with 1913, as monthly returns for that year were not published by the Union. For the 10 months ended Oct. 31 the make of steel was, in metric tons:

	Basic	Acid	Total
Converter	7,215,479	83,652	7,299,131
Openhearth	5,164,125	248,362	5,412,487
Direct castings	180,644	79,720	260,364
Crucible	.....	78,975	78,975
Electric	.....	72,730	72,730
Total	12,560,248	563,439	13,123,687

The total number of works reported as operating in October was 217, which compares with 202 in September and 238 in July. The smaller productions reported are in Lorraine, Luxemburg and the South German district. These returns show that notwithstanding all the troubles

and drawback due to the war, Germany was operating nearly half her blast furnaces and more than half her steel-making capacity.

British Steel

The British return does not cover any part of the war period. Steel production in Great Britain in the half-year ended June 30, 1914, is reported by the British Iron Trade Association as follows, in long tons:

	1914			1913
	Acid	Basic	Total	Total
Converter.....	414,875	239,757	654,632	888,526
Openhearth.....	1,815,371	1,183,117	2,998,488	3,205,983
Total.....	2,230,246	1,422,874	3,653,120	4,094,509

The decrease of 341,389 tons, or 8.3%, as compared with the first half of 1913, shows that the British steel trade, like our own, was feeling some depression in the early part of 1914, even before the war began.

The division of steel production in the first half of 1914 shows that converter or bessemer steel was 17.9% and openhearth steel 82.1% of the total. Taking another division, acid steel was 61.1% and basic 38.9% of the total make.

The production of manufactured steel products in the first half of this year is returned at 546,826 tons in bessemer and 2,422,126 tons in openhearth, these totals including forgings and castings made by the steel-ingot makers.

Copper in Idaho in 1914

By Robert N. Bell*

What appears to be the most important mineral discovery that has been made in Idaho, for a number of years, was disclosed during last summer in Adams County, at the north end of the Seven Devils mining district, on the Red Ledge group of claims. This deposit consists of a brillant red and yellow outcrop of siliceous porphyry in a region of dark, highly-altered diorite, or greenstone porphyry. The red porphyry is extensively faulted, sheared and sheeted and carries small amounts of gold and silver and traces of copper over its surface. The interesting feature of this deposit at present, however, is the discovery in a 300-ft. tunnel, driven in from the creek level in the greenstone for the purpose of cutting the red porphyry at a depth of 500 or 600 ft., at right angles to its course and at a depth of 200 ft., of a remarkably interesting body of gold- and silver-bearing copper ore. This deposit shows 30 ft. of spongy oxide mineral containing $7 gold and silver and a trace of copper, and 54 ft. of soft massive copper-iron sulphide mineral with a vertical schistose structure that averages 4.6% copper and $5 in gold and silver. The rich secondary copper sulphides, bornite, chalcocite and covellite are conspicuously in evidence in the main sulphide mass. The apex of this particular mineral course, which is still in the greenstone wall rock, is covered with débris and its lineal extent is yet undetermined Next to the main contact, the red porphyry has a spongy, honeycombed texture at the surface, for 50 ft. in width and several hundred feet in length, and gives encouraging evidence of another massive sulphide orebody to be penetrated by the crosscut tunnel. The main red-porphyry mass is 2000 ft. wide and several miles long in outcrop and if it fails to materialize as a disseminated porphyry-copper deposit of workable value, its structural conditions promise other important ribs of massive sulphide smelting ore like the one already encountered and a deposit of considerable commercial importance as a new source of gold, silver and copper ore.

*State mine inspector, Boise, Idaho.

Scandinavian Notes

Special Correspondence

Sweden's output of pig iron electrically produced from Jan. 1, 1914, to June 6, was 16,367 tons. The total for 1915 is estimated at 40,000 to 50,000 tons. The Tinfos iron works, Notodden, the only electric smelter in Norway operating on a commercial basis, has recently sold 1700 tons of pig iron to a Danish motor works and foundry, and 350 tons to other foreign firms. An inquiry has also been received from Italy for a delivery of 500 tons. The Dunderland iron-ore mines are still hung up, and are likely to remain so while the war lasts, owing to the requisite plant being held by Krupp. The Norwegian government has granted a concession to the Saude Falls Co. for the acquirement and regulating of the Store River, on the west coast, in accordance with the terms fixed by the Storthing. These are a concession period of 65 years, with right of redemption by the state after 40 years, a yearly royalty to the consumers of 50 öre per natural horsepower for the first 10 years, 75 öre for the following five years, and afterward 1 krone. A similar scale of royalties is payable to the state. The estimated power is 90,000 hp. At the same time the Electric Furnace Products Co., an American concern, was given permission to lease up to 80,000 hp. from the above proposition for a period of 40 years, after which the works may be taken over at their "technical value."

The Norwegian government has prohibited the export of unwrought copper, with the exception of that produced by Norwegian works and accompanied by a certificate of origin. Also rolled or pressed plates of copper of at least 3 mm. thickness, rolled or forged bars of copper or brass, rolled wire of copper or brass, copper or brass suitable for cartridge manufacture, and copper alloys.

The net profits of the Alby United Carbide, Odda, for the year ending June 30, were £66,252, with a carry-over from the previous year of £16,399. The company which has recently paid an interim dividend of 5% on the ordinary shares reserved further distribution, *pro tem*, on account of the war. The Meraker Smelteverk Co., of which the Alby United owns half, has shown a profit of about 400% of the book value of the proposition. The smelter, owing to the strong inquiry for ferro-chrome, has been in full operation and the prospects for the current year are particularly bright.

The export from Norway of unwrought aluminum has been prohibited from Dec. 24, 1914. An exception is made in the case of aluminum produced at Norwegian works accompanied by a certificate of destination.

State Geologist of North Dakota

In our issue of Jan. 9, we erroneously stated that H. A. Hard was State Geologist of North Dakota. We have since learned that A. G. Leonard is still State Geologist, which office he has held for the past 11 years.

Canadian Molybdenite Deposits

By W. H. Smith*

SYNOPSIS—The great demand for molybdenite at the present time has drawn attention to the Canadian deposits, which are described here. They occur both in the east and west, the richest being in the Sheep Creek district of British Columbia. Large capital is not required for the successful working of the deposits.

Molybdenite is found widely distributed through the immense granite-gneiss areas of the Canadian Shield, included in the provinces of Ontario and Quebec. Other occurrences have been noted in Nova Scotia, New Brunswick, British Columbia and the Yukon Territory. The Ontario and Quebec deposits are mainly of two distinct types, which are both evidently genetically connected with the Laurentian granite-gneiss erupture.

One type is represented by dikes of coarse quartz-feldspar pegmatite, which, as a rule, follow the foliation of the inclosing gneissic rock and often attain large dimensions, both laterally and transversely. Molybdenite is found in these in small bunches and short, narrow stringers, the mineral in them always being of the crystalline, platy variety, sometimes showing near the surface a slight amount of alteration to the yellow molybdite. As a rule, the plates of mineral vary in size from ¼ in. to 2 or 3 in. in diameter, and rarely exceed 1 in. in thickness. Disseminated mineral is rarely seen in this type of ore body.

The molybdenite is easily separated from the adherent gangue by hammer and chisel, and 80 to 90% of the ore can thus be recovered in many cases. The coarsely crystalline texture of the pegmatite is favorable to hand sorting, as the molybdenite folia have but little adhesion to the faces of the quartz and feldspar individuals.

Usually the bunches of mineral follow one wall or the other of the dike, and often penetrate the first 4 to 6 in. of the inclosing gneiss, which is usually impregnated with iron pyrites and oxides. The limits of the ore-bearing streak are clearly defined by this rusty gneiss on the one side and a discoloration of the pegmatite inwardly. Individual bunches of mineral are often connected by thin knife-blade seams, slightly stained with iron oxides and the yellow molybdite. The slightest coloration of the latter mineral needs to be followed assiduously, as it invariably leads to another bunch or pocket.

The other type of deposit consists of veins of pegmatite, pegmatitic quartz, and greenish pyroxenite, the latter being impregnated with considerable pyrite and pyrrhotite. These always occur along or adjacent to the contact of the granite-gneiss with bands of crystalline limestone, pyroxene having been developed in the latter by contact metamorphic action. The greater number of the eastern Canadian deposits are of this type, which promises to be the more productive of the two, but often contains a large proportion of disseminated mineral for which concentration treatment is necessary. Both the unaltered limestone and the pyroxenic bands carry molybdenite, which appears to be always more abundant along the margin of the pegmatite, or pegmatitic quartz when it is present. In the pyroxenite and pegmatite the mineral exists in bunches, and sometimes intimately mixed with the iron sulphides. Through the limestone both bunches and disseminated mineral are found, the latter being in the form of small scales which are barely less than $\frac{1}{16}$ in. in diameter. Molybdenite has also been found in simple quartz veins cutting granites and granite-gneiss. In these cases the mineral is often associated with bismuthinite, fluorite, tourmaline, muscovite mica, and sometimes cassiterite, wolframite, hübnerite and radio-active minerals of the columbite group.

In British Columbia molybdenite has been obtained at one or two mines in massive form, and when this is free from gangue it constitutes a most valuable ore. On the other hand, if impure, the difficulty in handling it by any known concentration method renders it useless. The leading Ontario deposits are situated in the townships of Somerville and Lexton, Victoria county; Cardiff, Harcourt, Lutherworth, and Glamorgan, Haliburton county; Sheffield and Denbigh, Addington county; Anstrouther, Peterboro county; Clarendon, Miller and North Canonto, Frontenac county, and Lyndoch, Mattawatchan, Brougham, Sebastopol and Ross townships in Renfrew county. Through Quebec the important occurrences are found along the Gatineau valley and in Pontiac county, including the townships of Egan, Alleyn, Aldfield, Aylwin, Wright, Bouchette, Clarendon, Litchfield and Waltham. Quartz veins carrying molybdenite, bismuthenite and fluorite have lately been opened up near Lake Kawagama in northern Pontiac, Que., 15 miles south of the Transcontinental line of the Grand Trunk Pacific Ry., their appearance being highly promising. Another district that merits attention is that along the north shore line of the Gulf of St. Lawrence, eastward from Anticosti Island. The principal locations here are in Manikuagan Bay and on the island nearby called Romaine. About 100 miles further east along the shore and on McKenzie Island, is another noteworthy deposit on which some work has been done.

The Nova Scotia orebodies are situated at or in New Ross, Lunenburg county, Jordan Falls, Shelburne county, and Halifax, Cape Breton, Yarmouth and Victoria counties.

Most of these are quartz veins in granite or granite-pegmatite, and the association of minerals in these cases clearly indicates the pneumatolytic origin of the ore. In the province of New Brunswick, and on the southwest Miramichi River, molybdenite is found accompanied by wolfram.

Of the western occurrences, those on Sheep Creek and its tributaries in the vicinity of Salmo, B. C., seem to be the only ones of economic importance yet discovered. They are possibly the richest of all the Canadian deposits and are reported to average 8 to 10% molybdenum across their entire width. The inclosing rock is a granite gneiss, and tungsten minerals are found associated with the molybdenite.

The Ontario and Quebec deposits may be said to vary in their content from 1½ up to 5 or 6% molybdenum. Ore is now accepted by buyers carrying as low as 20% MoS_2, and all the deposits will yield a good proportion of such a grade. In many cases a certain amount of clean

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flake mineral can be hand-picked out that will run from 98 to 99% pure sulphide. The second-grade ore, vein material carrying disseminated mineral and the residue from hand-sorting operations, would have to be treated by some method of concentration. This matter has in the past acted as a deterrent to those who would otherwise have engaged in the mining of the mineral. It has been supposed that the recovery was a most difficult undertaking and necessitated the employment of complicated and expensive equipment. Recent experiments have, however, shown that by combining water concentration with either oil flotation or an electrostatic method a reasonable saving may be effected.

Any units employed would be necessarily small as it would be generally possible to confine mining operations to the breaking of a comparatively narrow streak, producing a minimum of milling material. Great care must be exercised in the breaking of all ground containing lump ore and the holes so placed as to avoid sheltering the mineral as much as possible.

The Canadian molybdenite deposits are fully worthy of thorough and systematic exploitation. It must be borne in mind that the hand-picked mineral may defray a large portion of development expense and would now be easily disposed of at most attractive figures.

Making Cyanide from Cyanamide

Of particular interest at the present time, due to the shortage of cyanide in this country, is U. S. patent No. 1,112,893, granted to J. C. Clancy, of Colorado Springs, 51% of which is assigned to the Portland Gold Mining Company.

Clancy announces that it is a known fact that cyanide may be derived from commercial cyanamide by fusing it with sodium chloride, sodium carbonate, or potassium carbonate. Owing to the large percentage of lime and other impurities contained in commercial cyanamide, the fusing of this compound is rendered difficult unless a large proportion of flux is used. The salt which gives the largest yield in cyanide is potassium carbonate, but its cost is prohibitive for commercial use. Sodium chloride or sodium carbonate requires high temperatures, and the yield is so small that the production is not satisfactory. Clancy makes use of the peculiar action which is produced when an alkaline sulphide, such as sodium sulphide, is used in combination with salt in the fusion. If equal weights of sodium sulphide and cyanamide are heated with a proportion of carbon equal to one-fifth of the weight of the cyanamide taken, to a temperature of from 800 to 1000° C., alkaline cyanide is formed to the extent of 25% of the weight of the cyanamide taken. The resulting product contains a large amount of soluble sulphide. If equal parts of cyanamide and sodium sulphide are heated to the same temperature with the same proportion of carbon in the form of soft coal, the yield of cyanide is increased to 55% of the weight of cyanamide taken. It is desired, however, to get a product free from soluble sulphide, and containing a large percentage of cyanide which can be used in treating gold and silver ores. The result is accomplished by heating cyanamide with an equal weight of a mixture consisting of 50% sodium sulphide and 50% sodium chloride, with the addition of pulverized coal in the proportion of one-fifth of the weight of cyanamide taken. The cyanamide is thoroughly mixed with finely divided sodium sulphide and sodium chloride with the pulverized coal, and heated in a crucible or furnace with exclusion of air, up to 800 to 1000° C. As soon as volatile products cease to be given off, in practice 15 to 20 minutes after reaching red heat, the process is complete.

Nodulizing in Copper Metallurgy

By James H. Payne*

Usually when the copper metallurgist is approached upon the subject of nodulizing, his mind wanders back to the days of the Brückner cylinder and he shakes his head in doubt. If questioned, though, he will tell you that one of the worst troubles with the Brückner roaster was that it nodulized. Not having any way to get out, the nodules soon became snowballs, churning up meanwhile a cloud of dust. In order to get around this, the cylinder was tipped and became known as the White-Howell roaster. It is not clear just why White-Howell roasters never came into wide use, but it is probable that the pronounced success of the multiple-hearth roasters, which appeared about the same time, prevented this.

Nodulizing Practiced in Iron Metallurgy before Being Applied to Copper

At any rate the nodulizing kiln, which is simply a White-Howell roaster with the internally fired features of the cement kiln added, began to come into wide use about the year 1904 upon iron ores, such as flue dust, pyrites cinder, and the clayey Cuban ores.

When seeking to introduce the same idea into copper metallurgy, I approached Lawrence Addicks, then of the U. S. Metals Refining Co., upon the subject; nothing had been done with copper ores so far as we were able to learn. After a few preliminary tests, I made a demonstration run, witnessed by Mr. Addicks, which resulted in the installation of a nodulizer at Chrome, N. J., to treat copper flue dust.[1]

Nodulizing copper flue dust and low-sulphur ores does not differ materially from iron practice. The temperature, and consequently the fuel consumption, is much lower. Oil is too expensive a fuel for use on iron ores, although several nodulizers are running on oil, using 15 to 20 gal. per ton of nodules. Powdered coal is the favorite fuel, the consumption being about 12½% on the weight of nodules. Where the softening or sintering point is as high as 1800° F., there is no reason why powdered coal cannot be used on copper ores. It is quite as readily controlled as fuel oil and where a battery of nodulizers is in use it would prove a great economy over oil.

Copper ores differ from iron ores in that they carry no preponderating amount of any one element and therefore generate a much more vigorous chemical action at the sintering temperature. This enables them to be run at higher speed and makes them generally much easier to agglomerate to larger sizes.

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[1] "Eng. and Min. Journ.," May 24, 1913, p. 1037; Bull. of A. I. M. E., July, 1914, p. 1671.

Nodulizing Sulphide Concentrates

When the attempt is made to nodulize sulphide concentrates, conditions are at once seen to be entirely different from the simple cases of iron ores, copper flue dust, etc., because of the sulphur. Whether it be desired to retain all sulphur possible or whether roasting be desired before agglomeration, the effect of sulphur in excess of 10% or 12% is to heat the material, due to oxidation, above the point of incipient fusion for a considerable distance beyond the normal nodulizing zone; and this over-heating soon results in slag and matte formation, which makes operation impossible.

After considerable study and experimentation in a 20-ft. test kiln, at Yorktown, Va., I developed two methods of controlling this over-heating, one applicable where low sulphur is desired in the product and the other where high sulphur is wanted.

Controlling Overheating with a Diluent

The first method (U. S. Pat. 1,114,029) consists in adding to the material before feeding to the rotary a small percentage of a diluent, preferably of a refractory nature and in a fine state of subdivision, which will raise the melting point of the mass. In practice it is applied principally where low sulphur is desired in the product, and air is therefore freely admitted. The refractory diluent (which may be silica or siliceous ore or limestone) has the effect of holding apart the extremely fine sulphide particles and allowing them to roast, so that the material by the time it reaches the true nodulizing zone is low enough in sulphur to be controllable. The diluent also has the further effect of increasing the "range," or, in other words, the margin between incipient and liquid fusion, thereby reducing the slagging or matting effect. In the case of jig concentrates, the quantity necessary to use is not over 10%, as it is only the extremely fine sulphide particles that cause trouble. In the case of flotation concentrates, from 10 to 20% is necessary.

Sealing the Discharge End of the Kiln

The second method (U. S. Pat. 1,114,030) consists in nodulizing under conditions practically devoid of oxidizing effect upon the sulphur of the charge. In practice it is applied when high sulphur is desired in the product. The rotary is built with a seal at the discharge end so as to limit in every way possible the entrance of air over and above that necessary to burn the fuel. As a means of controlling the excessive slagging effect of the oxidizing sulphur this method has marked effect, enabling the nodulizing zone to be held near the discharge end within reach of tools, as desired. It has the further effect of enabling high-sulphur nodules to be turned out, although my original idea was simply that it would avoid the excessive overheating that the sulphur produced as it oxidized.

The application of these two methods has made it possible to handle successfully all ores so far tested, and the desired result as regards sulphur content in the product has in each case been obtained.

Advantages over Blast Roasting

In view of the increasing quantity of the extremely fine sulphide concentrates being produced by flotation methods, the introduction of a one-step agglomerate process will undoubtedly prove to be an important advance in metallurgy. Owing to their high sulphur content, which varies from 25% to 35%, they must be either partially roasted or mixed with a diluent to reduce sulphur to about 17%, if they are to be sintered by a blast-roasting process. Roasting makes a two-step process, and a large amount of flue dust is produced with such extremely fine material. Dilution is in many cases impracticable, as the concentrates are frequently self-fluxing. Briquetting has not proved practicable because the briquettes soon swell and burst when subjected to heat, due to the escape of sulphur.

One of the great advantages in the nodulizing process is, then, that concentrates can be fed directly to the apparatus without addition of other material or any special attention to the water content, and a highly satisfactory blast-furnace product obtained carrying any desired quantity of sulphur. This is particularly important from a pyritic-smelting standpoint. Flotation concentrates are well adapted to pyritic smelting, being self-fluxing and high in sulphur. It is possible to make nodules carrying 14% to 15% sulphur, sufficient to make pyritic or semi-pyritic smelting possible.

If, on the other hand, conditions are such that low sulphur is desired in the nodules, it is possible in the case of many ores to reduce sulphur to 6% or 8% without addition of other material. In other cases addition of 10% to 15% of a diluent is necessary—not enough to spoil the fluxing properties of the ore. Since the cost of nodulizing is about the same as the cost of multiple-hearth roasting of an extremely fine material like flotation concentrates, it is probable that nodulizing in this case will be able to replace roasters in reverberatory smelting. The small amount of fuel required to nodulize is more than offset by the freedom from flue dust in the reverberatory, and the greater speed which the furnace will have in smelting the already partially melted nodules.

Capacities and Operating Costs

As units of 100 to 150 tons' capacity per 24 hr. are practicable, and as one man can readily attend two furnaces, the labor cost is low. The fuel-oil requirements for a small unit of 50 tons were from 6 to 8 gal. per ton of nodules in the case of three oil-floated ores of widely different analyses. For a large unit, the fuel consumption will be less. Repairs are low; a lining which lasts six months to a year is the only part subject to constant replacement. Only 25 hp. is required for 150 tons' capacity. The cost of a 150-ton unit should not be over $12,000, including building, and therefore compares favorably with multiple-hearth and blast roasting.

Aside from the advantages of sulphur control, simplicity and low-operating costs enumerated above, a further important point is that the nodulizer makes absolutely no flue dust when operating on wet flotation concentrates. This will be doubted by acquaintances of the Brückner cylinder, I know, but it is true nevertheless. As the material is moving forward at a rapid rate, due to the inclination of the furnace, the particles soon reach the zone where they begin to roast and get just sticky enough to cling to their neighbors. That makes them too dense to be influenced by the draft, which, by the way, is extremely light. Any particles that do start out of the tube are precipitated in the atmosphere of steam near the entrance.

As regards the formation of accretions or "rings,"

this is an inherent defect in the nodulizing of all materials to a greater or less extent. The tests so far made upon oil-floated concentrates in the nodulizer at Chrome show less ring formation than upon flue dust. In neither case is the trouble as serious as in the case of iron ores because of the lower temperature employed, which makes the accretions more friable and causes less loss of time waiting for the furnace to cool. A furnace cools in 12 hr., so that it can be entered, and six hours' labor of two or three men is sufficient to put a furnace into a clean condition, after 18 hours' total loss of time.

The accompanying analyses of green ores and concentrates successfully treated serve to give an idea of the wide range of the nodulizing process.

TYPE OF PRODUCTS NODULIZED

	Cu	Fe	Insol.	SiO_2	S	CaO	Gal. Oil per Ton
Flue dust	12.00	31.33	22.10	18.19	11.86	0.48	10
Green ore fines	2.60	27.20	30.98	27.28	17.50	11.92	6
Concentrates	6.13	35.91	20.79	....	21.72	0.51	8
Flotation concentrates	16.30	14.30	41.00	30.20	18.30	0.40	8
Flotation concentrates	12.30	23.40	31.90	28.80	25.40	0.40	6
Flotation concentrates	15.00	30.00	18.00	15.00	32.00	0.43	6

The following screen test, while not representing the best results, is typical of the product when operating on high-sulphur flotation concentrates to the best advantage as regards fuel economy and condition of furnace: Between 1 in. and ½ in., 13.60%; ½ in. to ¼ in., 18.85%; ¼ in. to ⅛ in., 40.55%; ⅛ in. to $\frac{1}{16}$ in., 20.48%; 16 mesh to 20 mesh, 4.22%; 20 mesh to 40 mesh, 1.45%; 40 mesh to 60 mesh, 0.66%; 60 mesh to 80 mesh, 0.13%; through 80 mesh, 0.06%; total, 100%; percentage of voids, 44.50. Although this product does not at first sight appear to be an ideal blast-furnace product, it has been smelted without difficulty at Chrome in quantities up to 30% of the charge. Hot nodules direct from the kiln smelted so much more rapidly than the balance of the charge, however, that it was necessary there to cool them. It will be interesting to see if any difficulties are met with at Braden in smelting this product. Three nodulizers are now being put in there and the blast furnace will operate upon nodules exclusively.

Nodulizing of sulphide concentrates, particularly flotation concentrates, clears up the problem of treating such material because it makes possible pyritic or semi-pyritic smelting. Further, the operation appears to be such a cheap one that it may compete with multiple-hearth roasting in reverberatory practice. If so, it would be preferable to roasting because of the large amount of dust that roasters must necessarily produce when operating upon such extremely fine material.

In concluding this account of the progress made to date, I wish to acknowledge the credit due Mr. Addicks and Mr. Draper, the smelter superintendent at Chrome, who stood by the first nodulizer in its uncertain beginning; also to E. A. C. Smith, of the Braden Copper Co., and F. Y. Robertson, of the U. S. Metals Refining Co., through whose coöperation the adaptation of the process to flotation concentrates was fully demonstrated.

Production of Bismuth in 1913 in the United States is estimated by the Geological Survey at approximately 157,300 lb. and the imports for consumption of metallic bismuth were 117,747 lb. The prices quoted for bismuth ranged from $1.75 to $2.25 per lb., but production may readily exceed the demand as bismuth is contained in most lead and copper bullion.

Ponce de Leon

By T. M. C.

Shortly after the American occupation of Porto Rico in 1898, the island was visited by many tourists. Some of these were on scientific and semiscientific quests and by the liberal use of money brought to light many curios which had been treasured by the natives as family heirlooms. Among the latter were some curious black stones known locally as *piedras de rayo*. Some people conceived the name to be due to a popular superstition that the stones were meteorites; while others, who had in mind the claims which the possessors made regarding the curative properties, contended that the name should be translated to mean "stones of great power or efficacy of action."

Old voodoo doctors professed to have made wonderful cures by applying such a stone to ulcers and the like. Some stones were reputed to be "extra strong," and, therefore, of greater value. Like many native superstitions, the tales were commonly regarded as subjects for ridicule or for amused tolerance. Viewing the matter in the light of modern scientific knowledge concerning the sources and properties of radium, it is reasonable to suppose that natives of the West Indies have long possessed samples of uraninite containing more or less radium and that some of these contained sufficient to win for them the nickname of "stone of the rays of light."

Speculation on this warrants the reopening of the old case of Public Opinion vs. Juan Ponce de Leon, in which the defendant was convicted of the folly of seeking a fountain of perpetual youth and was sentenced to perpetual ridicule.

And it is proper for mining men to espouse, provisionally, the cause of a man who may justly be called the first mining engineer of the Western Hemisphere. Juan Ponce de Leon was practically the first man to make a careful study of the mineral deposits of Hispaniola and Boriquen, as the islands of Santo Domingo and Porto Rico were first named. His efficiency and tact in dealing with the natives gained him the post of Governor of Porto Rico. It is entirely reasonable to suppose that his intimacy with the aborigines led him to learn of such healing stones and that he may have personally witnessed an actual cure by radium. The instincts of a mining engineer would lead him to attempt some sort of investigation as to the source of supply of stones possessing such peculiar merit, even at the risk of courting ridicule. If, in the course of inquiries on this topic, he learned of vast and virgin fields for colonization, it is not surprising that he should have asked for and obtained a royal grant of this new territory in preference to retaining a post where malicious intrigues made life miserable.

The prototypes of the modern press agents must have existed in his day, and it is not at all difficult to conceive how a malicious humorist might concoct an elaborate yarn out of an incidental and subordinate motive.

Suppose, for a moment, that absolutely no progress had been made in the study of electricity from Franklin's day to the present, and that that gentleman had topped off his career with an unfortunate experiment with lightning. Then our public-school histories would teach us that Benjamin Franklin was a fairly smart man within certain limits, but that he was the victim of a foolish habit of playing with kites.

That Farm

By Mark R. Lamb

SYNOPSIS—The origin of the great mystery: What Becomes of All the Mining Engineers?

Choose from your last list of members of the American Institute of Mining Engineers the first 50 that stand high on the "D" scale. These men who get enormous salaries have all worked with a remarkable unanimity of aim. The experience of one is that of all. When surveying in a wet mine, working a night shift in an unwarmed mill in Nevada, teaching coolies to run a churn drill in Mongolia, or selling mining machinery in Bolivia, the vision that leads him on is the farm that he and the wife and children are going to enjoy just as soon as it is possible and the children are large enough to go to school. He reads those vicious stories in the *Saturday Evening Post* written by that man who covers apples, garden truck, chickens, rice, hogs and finance.

A trip through the apple district of Oregon will develop apple fever, though a more malignant form is developed by hearing the steam-shovel men on the Panama canal discuss the profits being made by Jackson, who used to fire on shovel No. 61. But the job in Oregon is short, and if the next one is in Brazil, our engineer will never think of anything but the profit from a coffee plantation, till he reaches Chile and figures the profits from shipments of the finest fruit in the world to New York in the dead of winter.

Men like Butters and Yeatman and Hammond can buy a large farm in Greater New York, and while they are learning farming the land will double in value, so they will not lose so much. I am not worrying about them. Even if they only lost their time and the entire investment, they would not be financially crippled. My concern is for the man like myself who has or shortly expects to have enough money to buy the farm and thus insure a secure and certain employment for his declining years and to his life's end. When he buys the farm he need never worry about finding something to do, and his years will decline and his life end promptly. All this is preliminary to the story of my life, or at least of the present part of it. I become a martyr to publicity in order to save you.

Providence, who is always on my side, decided one day to give me the farm experience below cost. To that end it was arranged that a certain Chilean gentleman should go to Europe and leave his city farm in my care. In Chile, a little farm of five acres in a city is called a quinta (keenta), and it is the same plot of ground that the stories located in Italy call a villa.

This villa is 30 min. from the office (walking or on the street car), so that I can leave the problem of "how to get the order" and take up the other one, "how to get a crop" with the loss of but a few minutes. You should know that my wife and I have enjoyed California fruit-ranch life, so we knew something about it. Stoping potatoes held no fears for us. As this vegetable has reached a prohibitive price in Santiago, we could figure the profit without a pencil. The profit we actually made on the potatoes was one of Rickard's new kind ("phantom").

But I must get this report right end forward. Raymond would make me begin over. And here is a good place to say that one of the reasons for writing this is so that Raymond will have some basis for my obituary. With what I give him here and his own efforts, he will be able to fill all the space allowed me. And an obituary alone at his hands is worth the cost of a life membership.

But to go back to the villa. The first move was to get a good farmer or gardener. Across the way was a Frenchman who had worked in Kew Gardens in London. Just the man! He came over, looked the place over carefully, said he liked the strawberry patch, thought potatoes should be planted in the west garden in order to clean it up preparatory to planting more delicate vegetables. (That sounded right—Irish preparing for aristocrats, you know.) He looked it over carefully, examined the peach and apple trees closely, said they had not been pruned for two years, and it was too late now to do it. He went over everything carefully, said it was a pity there were no tomatoes started, looked in the greenhouse and the artichoke quarter-acre and surprised me by asking how much I was ready to spend on the place in labor and fertilizer and insecticide and cyanide for scale, and seed and a pair of good horses for plowing, and a cart and the plow, and living rooms for the laborers, and a lot more that I have forgotten.

I asked for time to think it over. We discussed it and I decided that if it was necessary to put so much into plant I wanted to know the size of the shoot, the grade of the ore and what the copper market was going to be. But Mr. Gardener laughed at me. "It depends on the weather, the crops others have, the conditions at the hotels, the scale and other pests, and whether we follow the right lead or drift on a stringer and someone else gets the main lode." He suggested a possible pinching out of the potatoes, and his suggestions did not stop there, but it is now clear to me that he did not know the possibilities of my villa.

Finally, I gave him a free hand, but he decided to take a little piece of ground on his own account near by and grow early tomatoes. That is a great business in London and New York. People pay curious prices for the first of things. In Santiago they were just shipped in from Quillota and Coquimbo six weeks before we could possibly find a red one, and that, too, after buying tomato plants at specimen prices. The Frenchmen and I found this out at the same time exactly.

I did not get his help. Instead, appeared a Spaniard who had worked on the canal and knew how to handle American bosses. In looking back, I am surprised at how quickly the bargain was closed, but I suppose it was that.

Vicente decided what was to be done with every spot on the place. He got the potatoes in quickly. He bought the horse, the plow and the garden tools, with an assortment of seed. At first we were both enthusiastic, getting up at daylight and getting all the household out also. Even this early I could see disaffection creeping in. Part of the family wanted to stay in bed until six o'clock. We had a nice little stream of river water ditched through the place, and it was great fun at first to direct this

stream at the various patches of ground. It reminded me of hydraulic mining in Trinity County, and I think now that it must have reminded the gardener of the same thing.

My Chilean gentleman had many rare trees, plants and flowers on the place. I remember one peach tree that leafed out before the others, which had a curious curled leaf. I called Mrs. Lamb's attention to it, and we watched the blossoms expectantly until a bulletin from the U. S. Department of Agriculture let us into the secret. The secret was, briefly, "Peach curl, caused by a bug, spraying with Bordeaux mixture is a help, remedy unknown."

That tree didn't have a peach.

The potatoes started out fine. Green and thick they grew at first, and the Spanish gardener hoed high the hills, much against the advice of Hernandez, the Chilean gardener, who said the roots were being cut. I sided with Vicente because I remembered that Lincoln had hoed potatoes. After a time the potatoes began to look sickly. There were no bugs, at least none that we could see, and Vicente said it was a blight and Hernandez smiled and said nothing. Hardly anyone had potatoes this year, and they are three times the price of the last year. We didn't even open up a drift, and it required five bags of seed potatoes to do the planting. Vicente said when the tops began to wither that that was a sign the potatoes were ready to harvest, but this was before his explanation of the blight. Those tops dropped so quickly they rotted on the ground, and we had to bury them quickly to avoid the plague. This year we will do it different. We have been saving the slacked lime from the acetylene plant. (I have to make the gas every morning and sometimes I forget, and there is an intermission in the dinner schedule.) This lime mixed with copper sulphate is death to scale and blights, and I like to make it. It reminds me of making up standard solutions on the cyanide plant.

Our first crop of cabbages was a failure, so we used a large quantity of the above solution on the next crop and planted more than necessary, in order to have a reasonable crop. This time the cabbages grew 2 ft. high and 18 in. in diameter, and we harvested 2000 of the best. By desperate efforts we could eat two a week. The gardeners only ate them for a short time. Of course, our large crop coincided with other similar large crops. Whenever I smell cabbage now, it conjures up a vision of a huge pile of cabbage heads in the back lot, with two horses and a cow trying to make inroads on the outer edges of the heap.

There were 10 *palta,* or alligator-pear, or *aguacate* trees on the grounds. These did not bear the first year. I asked for advice, and got a lot, but finally became discouraged about advice and expert opinion. The difficulty was solved by asking only one man at a time. If by any mischance I would mention the *palta* trees, or the artichokes, or the potatoes, or the other things which had not borne as they should, and there were two or more men present (whether agriculturists or not), the discussion resulting was almost sure to lose me at least one friend and start a free fight. The *palta* should be pruned drastically—it should never be pruned. The bark should be beaten as the walnut is—the tree is very susceptible to bruises. It should not be watered—it should be watered very frequently and liberally.

The quarter acre of artichokes died because they were cultivated too closely, because there was not enough water, because they were drowned out, because they only live three years, and finally because they were not cultivated enough. I lost one order for a nice little lead smeltery because Dr. River and one of the directors tried to advise me at the same time. Their company is now in liquidation, and nothing will convince me that there is anything to blame but the artichokes.

The horse Ajax was the best investment of all. The Spanish gardener bought him for 95 pesos (look up the value of a peso here), and he was fat and willing. We planted the pasture with alfalfa, intending it for him and Minerva, the cow. I could write pages of his history, but it would be too painful—for me. He slowly pined away, in spite of alfalfa, barley and baled hay. An American said he had bots, and the gardener said he had *avas,* which is something in the roof of his mouth that has to be cut. He also had something, the remedy for which was black gunpowder dissolved in water. He was treated for all these. The man who led him away insisted that I should pay at least five pesos, for fear the horse died on the way.

But the pig—there was the success of the place. Of course, the pig belonged to Hernandez. We named him Benjamin Franklin for his numerous discoveries. He grew and thrived and is still growing, but if Hernandez notices it, he says nothing to me. There were two turkeys on the place when we arrived, and as everyone knows how difficult it is to raise turkeys, we decided to give them no attention or thought and save our efforts for the garden. It seemed a pity to keep them penned up, so we turned them out. They helped keep the bugs and grasshoppers off, but they also liked strawberries. At first they were reasonable and only ate ripe berries, and ate them all up, but becoming bolder through immunity, they began to peck little holes in the partly ripe berries. This was too much. Then when the 13 little ones began to learn the habits of their parents, we held a council of war—and decided to double the berry patch, reserving a part for ourselves.

Except that the *Saturday Evening Post* has asked me to write an article on the commercial opportunities for American manufacturers in South America, I could tell you more experiences. We have been on the place now two full years, so it would take me two years to tell it all.

What you should do first after reading this far is sit down and write me what was the matter. I am sure you could do it. No one has yet said he did not know what we should have done. After that, you might again look up that farm, and perhaps buy it this time, determined to show a waiting world that *you* will not make a botch of farming because other mining engineers do it.

I have an inquiry this morning from a man who is beginning mining, just as you will be beginning farming, after you make the first payment. When you begin to lose faith in your ability as a farmer and look around for help, your letters to the Department of Agriculture will sound to them more or less like the following sounds to you, and you may judge how little you know about farming from this letter: "Our mine is now producing five tons of lead ore daily, but this can be greatly increased. If you find any radium or other valuable products in the sample sent you, please advise us and we will take it up later."

British Guiana Produced in 1913, 77,435 oz. of gold and 94,871 diamonds weighing 12,506 carats. Promising showings of bauxite and lignite are also reported.

Johannesburg in War Time

SPECIAL CORRESPONDENCE

The outbreak of the war found the mines with fairly good stocks of all necessary stores and trusting to Great Britain being able to maintain command of the sea. Arrangements were soon made to obtain from other sources any goods formerly supplied from Germany, and so far no shortage has developed. It is rather a curious fact that about three weeks before the outbreak of the war I was informed by an engineer of one of the largest German firms here that they had received instructions to realize all stock at cost price, the ostensible reason being that trade was slack. Today the position is unique; nearly all the gold produced is somewhere near Cape Town lying to the credit of the Bank of England, which credits the company's account here and in London with 97% of its value.

The mines work as usual, and another mine, the State Mines, started up its 100-stamp, 50,000 tons per month mill in October. Trains arrive from Durban and Cape Town, yet the Rand is emptied of something like 10,000 of its young workers, one group, the Rand Mines, having sent 1000 men, and another 8000 are drilling for local defense. All over the Transvaal and the Orange River Colony a civil war is going on, while other forces are engaging the German troops in German Southwest Africa. The great bulk of the people of the country, especially the educated Boers, the Colonials and the British, support Botha and the British flag.

The rebellion is partly due to political rivals of Botha and partly due to race hatred and a desire for retaliation, sentiment and a longing to see the national flag again raised, among the ignorant and isolated farmers of the back veldt. There are 40,000 troops in arms for the government, and so far everything points to internal peace being quickly restored. The war seems to have destroyed all hope of raising the twenty millions of fresh capital needed to keep up the output of the Rand by developing the untouched area of the East Rand, and this despite very favorable results obtained by those mines which are developing. The State Mines has in four years' time sunk four seven-compartment shafts, two to 2300 ft. and two to 3600 ft., and has developed over two million tons of reef valued at about 27s. per ton. The Modder Deep has exposed reef, by 22,000 ft. of development, assaying 9.28 dwt. over 47.8 in., and has 2½ million tons of this ore ready for the 30,000-ton mill which is to start work at the end of the year.

Development at the Springs mine about five miles to the southeast of these mines, with no shafts being sunk between, has shown a large proportion of reef of good value, though development work is curtailed owing to the war. Three miles or more to the southeast of these mines, the Daggafontein shaft has struck reef at a depth of 3570 ft., assaying 8 dwt. over 40 in. Development has been suspended here also for financial reasons. Working costs are in almost all mines showing a substantial reduction and the outlook for the investment of new capital should be bright. The government has in the past asked too high a percentage of profit for the leasehold rights of its ground, and there is some hope that after the war it may be able to offer more attractive terms and to attract capital.

Some Electrical Developments in Mining in 1914*

An interesting railway is being constructed by the Bethlehem-Chile Mines Co. in Tofo, Chile. This road will be used for conveying iron ore from the mines, about 2000 ft. above the sea level, a distance of about 15 miles to the Port of Cruz Grande on the coast. The equipment of this road will include three 110-ton, 2400-volt direct-current electric locomotives which will be supplied energy by two 3-unit 1000-kw., 2400-volt synchronous motor-generator sets. This substation will be fed over a 22,000-volt transmission line from a main power house, which will contain three 3500-kv.-a. and one 300-kv.-a. Curtis steam turbines. The average grade on this road is about 3% and the locomotives are to be equipped for regenerative control, feeding power back into the system on the down grades.

MINE LOCOMOTIVES

All of the mine locomotives manufactured by the General Electric Co. in 1914 were provided with commutating pole motors and ball bearings as standard equipment, and the operating records of those placed in service during the year show that these improvements have reduced the number of interruptions to service and have resulted in decreased maintenance costs.

The increasing output of many mines has rendered it necessary to equip with locomotives of relatively large capacity, capable of handling heavy trips over steep grades and for long hauls. For this class of service there have been built a number of three-motor, 15- and 20-ton locomotives. The 20-ton unit combines some unusual features in design and construction. The body is made of rolled steel, each side frame being cut from a solid rolled-steel slab, while steel slabs in conjunction with steel channels are used for the end frames. The three driving motors are each rated at 85 hp., and are of the split-frame type. These particular locomotives were built for 42-in. gage, but the same construction and capacity can be utilized for a minimum of 36-in. gage.

Uptodate practice in haulage locomotives may be represented by reference to the constructive features of a typical 16-ton single-truck three-motor unit. In this, the latest type of industrial locomotive, the truck frame is built of steel throughout, both the sides and ends being cut from single pieces of solid slab. The platform is built of steel channels and plates, and the cab of steel sheets. It is a standard-gage machine; and, in so far as possible, all details have been developed along the lines of standard railway practice, the wheels, axles, journal boxes, brake beams, brake shoes and couplings being all in accordance with MCB requirements. It is driven by two 60-hp., 500-volt motors and equipped with straight air brakes.

An interesting type of locomotive has also been constructed for service at the mines of the Braden Copper Co. in Chile. It is a 25-ton, double-truck machine for 30-in. gage, and has an overall height of only 7½ ft. The four driving motors are each rated at 45 hp., 250 volts; multiple-unit control and automatic air brakes are also included in the equipment. It is probable that this locomotive is the heaviest with the narrowest gage and the

*From data furnished by the General Electric Co.

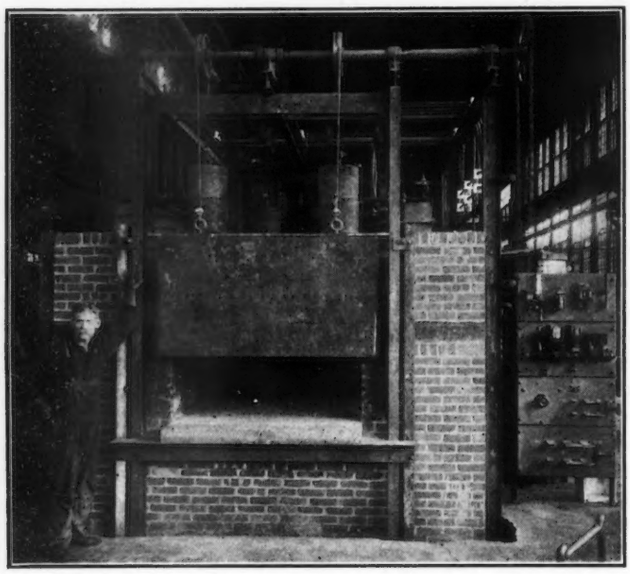
lowest overall height of any machine of this type ever built.

Mine Hoists

The largest induction-motor shaft-hoist equipment in America was placed in operation in November, 1914, at Lansford, Penn., for the Lehigh Coal & Navigation Co. The driving motor is rated at 750 hp., 300 r.p.m., three-phase, 25-cycle, and drives through a single reduction gear.

Positive control of the hoisting speed is secured by means of an improved type of liquid rheostat and high-tension air-break contactors, the motor circuit being 2300 volts. This hoist serves a 600-ft. vertical shaft hoisting 11,500 lb. per trip at the rate of 90 trips per hour with a maximum rope speed of approximately 1600 ft. per minute.

The liquid rheostat referred to above was developed primarily for mine-hoist service and insures safe operation at quick reversal. It employs two sets of fixed electrodes at different elevations. One set is widely spaced,



Electric Annealing Furnace, Resistance Type

while the other set has large electrode areas and has small spacing in order to obtain a very low final slip. The two sets of electrodes are connected in parallel after the electrolyte has reached a certain level corresponding to a predetermined decrease in rotor voltage. All parts of the rheostat itself are stationary, thus insuring absolute reliability. The electrolyte level is varied through the operation of a movable weir and a small motor-driven pump.

Electric Furnaces

The fact that the electric furnace offers a compact, reliable and economical method of manufacturing crucible-quality steel has now become more generally recognized among iron and steel founders and, in consequence, there has been an appreciable increase in the number and size of the equipment recently installed or in process of construction, and a concomitant improvement in details tending toward improved efficiency.

Perhaps the most striking advance has been in the induction type of furnace; for, prior to 1914, the largest unit of this type in the United States had a capacity of only two tons, whereas during the year this was carried to 20 tons, two units of this rating having been completed. This 20-ton furnace is of the two-ring type. In operation it utilizes single-phase current of five-cycle frequency at 5000 volts; and, in this connection, it has been necessary to supply a special motor-generator set, consisting of a two-pole single-phase generator having an output of 4000 kv.-a., which is direct driven by a three-phase, 25-cycle, 2300-volt synchronous motor.

The exceptional size of the furnace, which is the largest of any type in the United States, used for refining steel, is best understood by reference to the core and coils, which elements for each furnace have a weight of approximately 60 tons. In operation the furnace rings are charged with molten metal, every part of which is thereby subjected to intense, uniform and positively controlled heat, and is then poured off after a treatment lasting from 60 to 90 minutes.

For the arc type of electric furnace, special forms of transformers and auxiliary equipment have been designed, together with a reliable system of automatic control, which is particularly interesting to the practical operator in that, except for a short period after starting the furnace, a constant power input is maintained at such a value as may be predetermined by the operator.

The resistance type of furnace, which utilizes heat generated by passing the electric current through a resistor composed of foundry coke, with auxiliary heating from a carborundum arch radiating heat downward on the charge, has also been provided with a simple current relay control that insures the maintenance of a constant temperature over a range of approximately 600 to 1300° Centigrade.

Mineral Production of Austria in 1913

The output of mining and metallurgical products in Austria during 1913 and the two preceding years are officially reported herewith in metric tons, unless otherwise stated, the figures being taken from *Glückauf*. The labor statistics relate only to 1913.

Mine Products	1911	1912	1913	Workmen 1913
Gold ore	29,647	30,192	35,994	758
Silver ore	24,143	21,794	19,937	1,999
Mercury ore	111,018	117,780	130,608	998
Copper ore	10,974	17,354	16,353	753
Iron ore	2,765,815	2,926,686	3,039,324	6,270
Lead ore	23,845	27,952	25,751	3,614
Zinc ore	32,166	34,675	34,225	511
Tin ore	944	606	939	114
Antimony ore	270	4,520	1,270	26
Pyrites	15,805	13,996	10,561	171
Manganese ore	15,954	12,471	16,540	162
Graphite	41,599	45,375	49,456	967
Lignite	25,152,601	26,283,690	27,378,332	55,194
Bituminous coal	14,487,550	15,797,890	16,459,889	71,015
Uranium ore	.....	11	11	207
Tungsten ore	.....	66	52	27
Asphalt	.....	4,234	3,026	121
Metallurgical Products:				
Gold, kg	205	204	284	(a)
Silver, kg	50,244	49,355	54,000	381
Mercury	704	763	820	194
Copper	1,760	3,057	3,685	202
Pig iron	1,596,148	1,759,850	1,757,864	5,627
Lead	18,097	19,993	22,312	432
Zinc	15,766	17,298	19,508	1,459
Tin	.....	13	11	(b)

(a) Included under gold ore, and silver. (b) Included under tin ore.

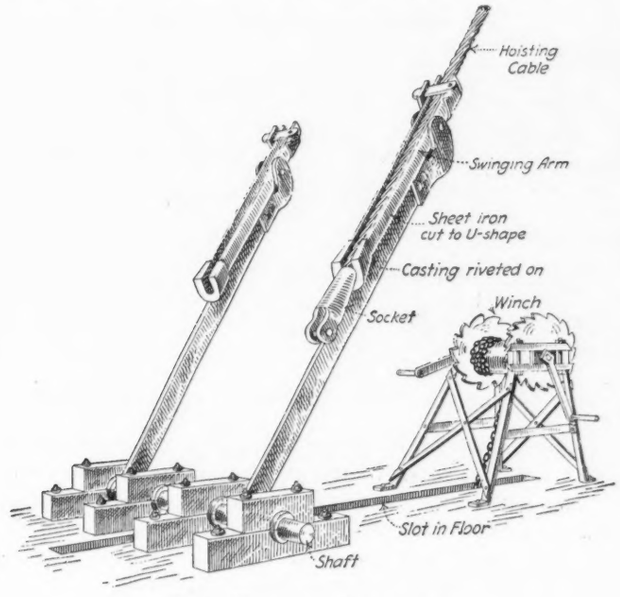
The total value of the mining output for 1913 is reported at 371,422,428 kroner, and of the metallurgical at 181,607,752 kroner, an increase, as compared with 1912, of 18,896,897 kroner in the former and of 2,395,140 kroner in the latter category.

Details of Practical Mining

Device for Holding Skip Rope

By L. Hall Goodwin*

The device used in the shafthouses of the Quincy Mining Co., Hancock, Mich., for holding the skip rope while one conveyance is being substituted for another on it, has advantages over the cruder methods generally employed. The arrangement consists of three arms rigidly fixed to a 4-in. round iron bar. The two arms shown carry the holders for the ropes, and each swings in an arc in the vertical plane which contains its respective rope. The third arm lies midway between the other two and extends beneath the concrete floor, a slot being left in the floor to allow the arm to swing; it carries a counterbalancing weight and also serves as a lever for rotating the bar.



Rope-Holding Apparatus

For convenience one holder is shown empty, the other engaging a rope. As a matter of fact the arms are in the position assumed when they are out of service; they are swung up when they are to be used.

The device is set at such a height in the shafthouse relative to the cranes on which the skips and man cars are stored that when one of them is swung into position over the track it will be at the right height for adjusting the clevis to the rope socket.

When a conveyance is to be changed, the holder is swung into position by rotating the arms until the holder engages the hoisting rope. The rotation is accomplished by means of a small hand winch which winds a chain attached to the counterbalance arm. On either end of the winch drum is a ratchet wheel, one of which holds the arms when in position, the other when out of position. The illustration shows the manner in which the holder catches the rope.

*Mining engineer, 3 Barstow St., Allston Station, Boston, Mass.

Safety around Surface Tracks

Surface tracks are used around practically every mine and metallurgical plant. They are a not infrequent source of accident. The *N. F. A. Safety Bulletin* offers suggestions toward promoting safety in the use and care of industrial railways, which are applicable not only to mine and metallurgical surface tracks, but also to the underground trackage.

In seeking to prevent injuries, it says, the condition of the tracks merits first consideration. The use of amply heavy rails will prove a safe and good investment, for heavy rails are not so easily damaged by hard usage as light ones and will wear much longer. To promote smooth passage of cars the rails must be substantially supported at sufficiently close intervals to avoid their sagging, binding or spreading; the rail joints must be well secured and in good alignment on both top and edges.

Where rails connect with a turntable, cars may be badly jolted or even thrown from the track altogether if the rails do not make good connection with the turntable or if the latter is not properly latched in line or if it is in a "rocky" condition. The same is true of switches which do not afford good and certain alignment. While jarring of loads or derailment of cars when carrying ordinary loads may cause injury by the falling of the loads upon workmen, the hazard is considerably increased when molten metal is being carried by such cars; it is then all the more important that the tracks be in good order.

Where workmen are frequently crossing tracks and are liable to trip over them or where it is necessary to wheel ordinary trucks and barrows across them, the tracks are frequently laid in concrete or set in wooden floors, with the rail tops flush with the floor, or the rails are cast as a part of rough-surfaced floor plates, laid level with the surrounding floors. When tracks are laid flush with floors, the grooves between the rails and floor form a catch-all for dirt and sweepings. These grooves must be kept clear to make the movement of cars safe and easy.

Where frogs or rail guards are likely to catch and injure workmen's feet they should be equipped with heel guards that will prevent the entrance of workmen's feet to an unsafe depth.

The position of the track may be a source of accident unless proper safeguards are provided. This is necessary, for instance, when a car runs on a track which forms a junction with another passageway and when, because the approaching car is hidden or partly hidden by piles of materials or by partitions or buildings, it cannot be seen quickly enough to avoid collision with men walking in the passageway. It may be feasible to deflect the footpath or the track to avoid this condition, or the piles of materials or the partitions or buildings may be moved from the junction of the track and pathway, and placed where their presence will not endanger workmen. If, however, these remedies cannot be applied it may yet be practicable to safeguard the hazard by the erection of guard gates or fences across the pathway where it meets

the track; this arrangement will serve to slow down temporarily the workman's pace as he approaches the dangerous point and thus allow him time to notice if the way is clear. Or the guard gate or fence may be swung across the track where it meets the pathway in order to slow down the speed of the cars themselves as they cross the junction. Such guards are especially needful where a doorway from or into a building leads directly upon tracks. In every case, signs with the inscription "Danger" or "Railroad—Danger" should be conspicuously affixed to the guard gates or fences.

Installation of automatic warning gongs on cars will also help to avoid accidents.

Where existing conditions make it necessary or convenient for workmen to walk on or about tracks which are located alongside fences, buildings or piles of materials, ample clearance must be provided, else workmen may be injured by passing between cars and these obstructions or by scrambling over stationary cars. If safe clearance cannot be allowed, the passage should be closed to all travel except that of the cars and of those who operate them. Here again proper danger signs will prove of great value in preventing injuries to workmen.

Switch levers should be arranged to throw parallel with the rails; when they are operated at right angles to the rails, the switchman is liable to be struck by an approaching car.

Sometimes the nature of the work requires that workmen should stay on industrial cars when they are in motion; ample clearance must then be provided to prevent the workmen from being jammed between cars and doorways or other obstructions. Coasting on cars should never be tolerated.

In some plants inclined tracks are used on which cars are propelled by cables or chains operated by a winch. Breakage of the cable or chain may precipitate an accident, and it is obvious that this extraordinary hazard warrants unusual care and constant watchfulness. The proper performance of car couplings and brakes is of particular importance on inclined tracks. It may be advisable, under some conditions, to fence in such tracks at points where loss of control may allow a car or train of cars to run down the incline. Portable rail-stops or permanent automatic rail-stops serve to check a runaway car or train, or blind switches may be installed at points where they will safely deflect or stop cars that have broken away from control.

The cars should be suitable for their purpose. This is as important from a safety viewpoint as it is upon grounds of economy and convenience. The attempt frequently made to utilize one type of car for all kinds of service is a mistake.

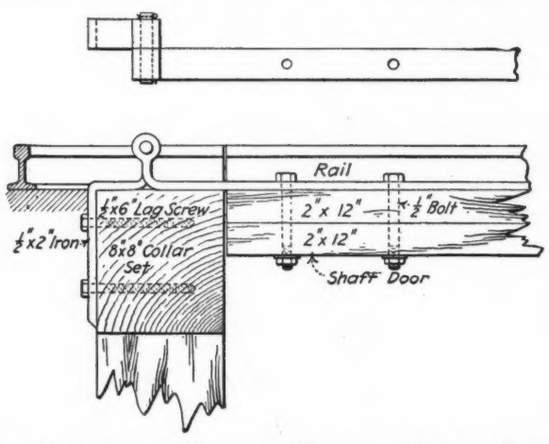
Cars are frequently used where moisture attacks the woodwork, corrosion weakens the iron parts and the bearings are exposed to sand, dirt and grit of various sorts. Such cars are subject to great wear and tear and therefore are particularlarly liable to cause injury to workmen on account of breakage or looseness of parts. Wear of axles, wheels or bearings may also cause poor alignment of the wheels, which may then bind when going around curves, or jump the track when passing over switches or turntables. All car bearings should be lubricated regularly, inspected frequently and kept in good order, particularly when used for handling molten metal or in especially hard service.

Wheels sometimes require guards or fenders. Accident records show that workmen frequently brace their feet against the track close to the car wheels, when the load is being lifted from or placed upon the car. In that case, the car has a tendency to lurch forward and crush the workmen's feet. It may be feasible to apply brakes or to wedge the car in place to prevent such accidents, but it is far safer to provide an appropriate guard on the car around the wheels close to the rails. Such a guard will prevent workmen from placing their feet on rails between the wheels, and will push their feet from the rails if they are in front of the wheels when the car starts.

Hinge for Shaft Doors

By Clinton P. Bernard*

While shaft sinking is in progress it is usually necessary to place doors over the shaft at the collar for preventing muck from going down, and for carrying the rails if the material be dumped into a car. The illustration shows



Shaft Door with Wrought Hinge of Special Design

a hinge for such doors which can be made by any blacksmith, and has several advantages over the ordinary flat hinge. The center of the eye is set level with the rail and away from the edge of the shaft a distance equal to the thickness of the door plus the rail. The hinge allows a close joint between the rails, while the door in a vertical position is entirely clear of the shaft, and when thrown back the rails are superimposed, thus relieving the hinge of all strain. The door half of the hinge has a bearing on the collar set to give added stiffness to the door.

Eureka Shoveling Machine

The underground loading machine built by the Lake Shore Engine Works and installed at the Judson mine near Crystal Falls, Mich., was described in the Journal of Sept. 19. A description of the success obtained in actual operation, furnished by M. E. Richards, general manager of the Judson Mining Co., and also interested in the manufacture of the machine, is timely: "We are now working our ore loader underground at the Judson mine and it is doing better work than we had expected at the start. However, as we anticipated, we are finding a few mechanical devices and details which we are chang-

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ing, in order to make the operation more simple, such as changing the length of teeth on the dipper, making the machine easier to get in and to operate, placing operation levers in a handier place, etc. Our trial runs so far have averaged loading a ton in from one to two minutes. We took just an ordinary pipeman out of the gang and put him on the machine, its operation being extremely simple. All the operator has to do is to open the throttle; the digging is automatic. The operator uses the propelling clutch to work the shovel in close to the bank and the swing clutch to load from all sides of the drift. From results to date it appears that we can at least cut our mucking cost in two, and it will make us much more independent in regard to labor."

Economical Pump Arrangement

By Howard S. Lee*

At the Rainbow mine in eastern Oregon it became necessary recently to provide an additional pump to take care of extra water encountered in development work on the lowest level. In order to be able to handle surges of water and still not incur the expense of a pump with a capacity much greater than the normal flow, an installation was devised by E. A. Hamilton, master mechanic. While the arrangement is not entirely original, it may be of interest to those having similar problems on account of its low initial cost and its operating economy as regards both labor and power.

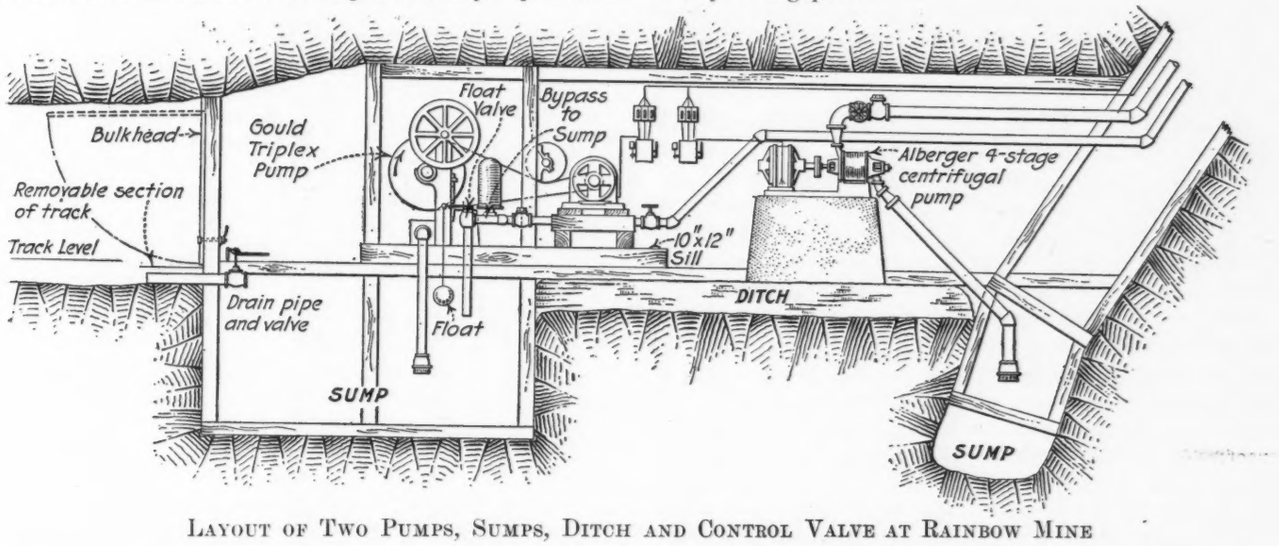
The pump already in use was an Alberger, four-stage centrifugal, with a capacity of 100 gal. per min., direct connected to a motor with a speed of 3600 r.p.m. This pump was connected to storage tanks on the hillside about 80 ft. vertically above the collar of the shaft, and the water thus pumped was used in the mill or allowed to overflow to waste.

The new pump is a Goulds triplex with a capacity of 175 gal. per min. It is connected by an endless balata belt to a 25-hp. motor. In order to place the belt and motor back against the wall and out of the way, the crankshaft and countershaft were turned end for end. An idler was applied to the top or slack side of the belt to give greater pulley contact and eliminate vibration due to belt whip.

*Mining engineer, U. S. Smelting, Refining & Mining Co., Rye Valley, Ore.

Both the pump and motor were placed on wooden foundations to save the cost of concrete. The sills were well braced and securely bolted and there is no appreciable vibration. The motor foundation was built 21 in. higher than the pump foundation which will permit 2½ ft. of water on the floor of the station before the motor is submerged. The pump was set above the sump to eliminate unnecessary bends in the suction and make it as short as possible.

A bypass to the sump and a check valve were placed in the discharge column of the triplex pump and the flow of water governed by an angle float-valve in the bypass. Between the two sumps there is a ditch 2 ft. deep and the float works within this range. By this arrangement the centrifugal pump can never be without water and only the excess passes through the triplex pump. It would have been possible to connect both pumps to the same water column, but as there was already another column in the shaft which discharged into an old adit about 160 ft. vertically below the storage tanks, this was used. Now only such water as is needed in the mill is pumped to the higher level; the excess is discharged at the lower level thereby saving power.



Layout of Two Pumps, Sumps, Ditch and Control Valve at Rainbow Mine

To regulate further the flow of water, a bulkhead was placed in the main crosscut which may be closed when the power is off or when it becomes necessary to reduce the amount of water entering the sump. This bulkhead was made of two thicknesses of 1-in. lumber and provided with a felt gasket next to the timber. It is hinged at the top and when closed may be fastened with bolts and wing nuts. A 6-in. pipe and valve were provided so that all water can be drained before the bulkhead is opened. A short section of track may be removed when the bulkhead is closed. When in place the track is fastened by four loose pins.

By this arrangement the flow of water can be regulated absolutely. In case of power interruption it is not necessary to use the auxiliary steam pump to keep the electrical pumps from being flooded and the expense of fuel, firemen and pumpmen in these emergencies is eliminated. In addition to this the triplex sump acts as a settling sump and no grit can enter the centrifugal pump. With the float-valve arrangement the water is maintained at a constant level and no pumpman is required.

Details of Milling and Smelting

Laist Roasting Patents

Frederick Laist, of Anaconda, has patented a roasting process for copper-sulphide ores and especially for roasting and chloridizing such ores when containing silver, with the idea of bringing the metallic constituents into a form suitable for leaching and final recovery by precipitation. The roasting may be an oxidizing or sulphating process, as well as chloridizing. The accompanying illustrations show the type of furnace suggested in U. S. patent 1,114,371 and 1,114,372, but the process may also be carried out in the furnace covered by Mr. Laist's patent No. 1,070,490. The process patent covers the roasting of a charge on one or more hearths in the presence of hot gases from an external firebox, removing the hot calcines from the influence of said gases and completing the reaction in a region of comparatively low temperature, salt and oxygen being added on the lower heat-insulated hearths where the reaction completes itself without further application of heat. Mr. Laist claims that the fuel consumption is minimized by this process, as is also undue volatilization of metallic chlorides.

In Fig. 1 is shown the roasting and chloridizing furnace suggested by Mr. Laist in U. S. patent 1,114,372. It is of the McDougal type with two fireboxes at opposite sides of the furnace. The products of combustion pass from the fireboxes into hearth No. 3, counting from the top. This hearth is deeper than any of the other hearths, there being left a clearance of from 10 to 12 in. between the upper surface of rabble arms and the roof; the gases from the fireboxes discharge into the third hearth through openings *Z* above the rabble arms at the outer edge of the roof. As will be noted in the drawing, the "marginal" drop hole *Y'* of the second hearth *B* discharges the material on the floor of the third hearth *C*. On hearth *C* the roasting ore is moving toward the center drop hole *Y;* also the ore is moving away from the fireboxes, this being an important feature of the process.

In any direct-fired furnace used for roasting copper ore for leaching, it is important to avoid overheating the ore, since to do so causes a portion of the copper contents to become insoluble in the leaching solution owing to the formation of a "ferrite copper." The temperature on the floor on the hearth *B* is approximately 540° F. Before the formation of insoluble copper ("ferrite copper") becomes serious, a temperature of at least 1100° F. must be exceeded so that the quantity of insoluble copper on hearth *B* is negligible and the relative movement of the ore and flame is thereover immaterial.

On the third hearth *C*, however, conditions are different. Here there may be a temperature of 1280° F. about 2 ft. from the furnace walls, midway between the drop holes (from hearth *B*) and the gas discharge or firebox opening *Z*, the temperature being even higher close to the opening from the fireboxes. The ore dropping from the second hearth *B* has a temperature of about 500° *F.* and were it permitted to move toward the region of high temperature on the hearth *C*, the tendency would be for portions of the ore to become overheated and rendered insoluble as above pointed out. This overheating will obviously be much reduced by having the comparatively cool ore enter said heated region and move continually toward a region of lower temperature, that is to say, toward the center of the hearth. Accordingly, in a multiple-hearth furnace roasting ore for leaching by direct

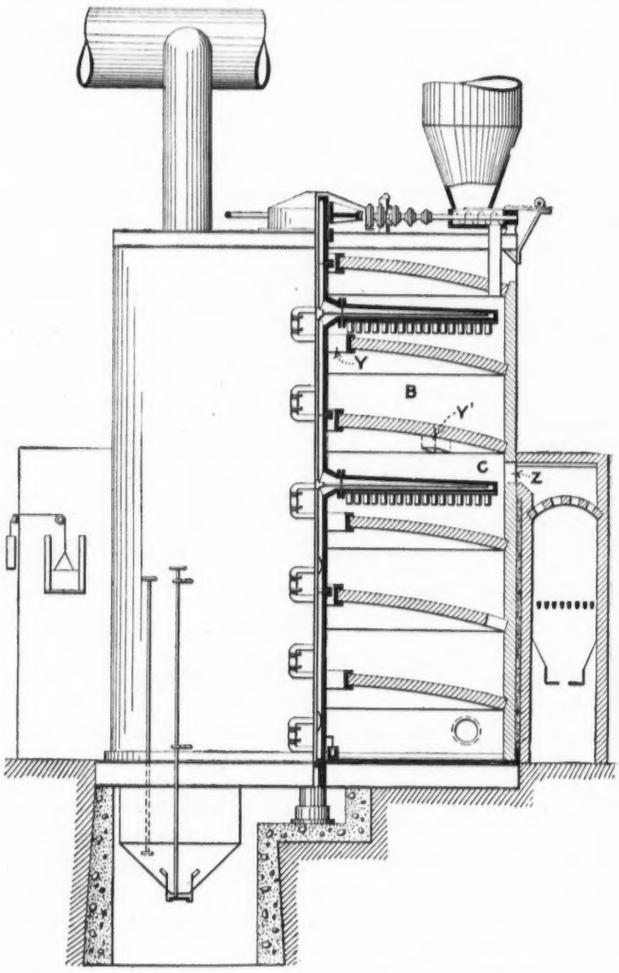


FIG. 1. ROASTING AND CHLORIDIZING FURNACE

firing, it is essential that the direct-fired hearth shall be one in which the ore is moved toward the center, away from the zone of high temperature. To minimize the destruction of the rabble arms and rakes on the hearth *C;* the openings from the fireboxes are, therefore, placed immediately under the roof of the hearth, which is sufficiently high above the rabble arms to permit the flame to clear the arms and play between the roof and the arms.

Three distinct types of roasting may be considered in this connection, says Mr. Laist in his patent: (a) The oxidizing roast, pure and simple, which contemplates the conversion of the metal to oxide; (b) the sulphating roast which contemplates the formation of the sulphate of the

metal; and (c) the chloridizing roast by which the metallic oxides and sulphates, together with decomposed sulphides, such as silver sulphide, are converted into chlorides of the metal. Mr. Laist's patent contemplates the practice either of the first two types or it may combine all three, depending on whether silver be absent or present in the ore. If no silver be present the ore charge is subjected merely to an oxidizing and sulphating roast; if silver be present then the charge is subjected to a combination of oxidizing, sulphating and chloridizing roasts. The ore is oxidized on the three upper hearths and sulphated and chloridized on the lower hearths, away from the heat supplied by the gases of the fireboxes. In the construction shown the furnace walls

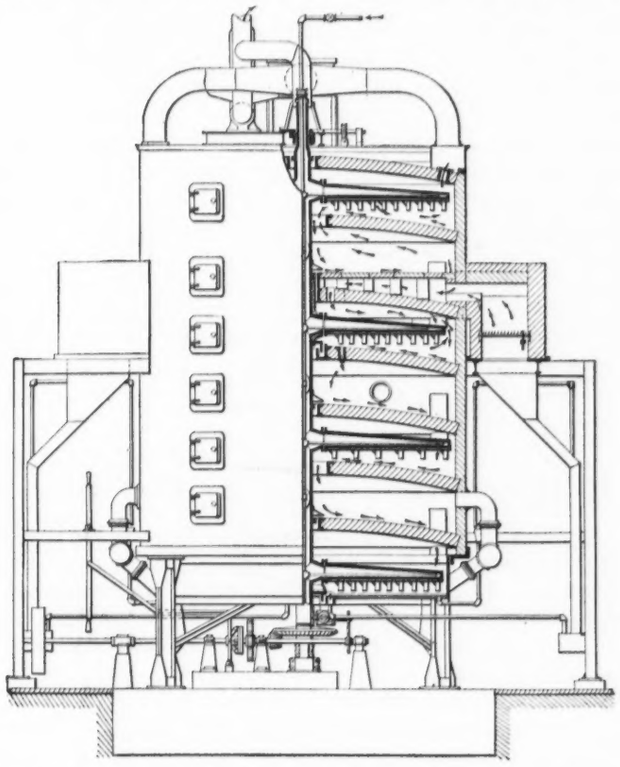


FIG. 2. ROASTING AND CHLORIDIZING FURNACE WITH MUFFLE OVER THIRD HEARTH

of the lower hearths are insulated against heat loss by radiation by a layer of asbestos or its equivalent or by making the walls sufficiently thick to prevent loss of heat.

In the upper part of the furnace the ore is oxidized, using this term in its generic sense; thus the copper sulphide is first converted into CuO and SO_2, any SO_3 which may form converting the CuO into $CuSO_4$, and the result is a mixture of CuO and $CuSO_4$, the sulphating process being an oxidizing one, speaking generically. Assuming that the ore treated is a copper sulphide carrying silver, the product of the oxidizing roast from the upper hearth is probably a mixture of CuO, FeO, Ag, Ag_2S with small quantities of Cu_2S, $CuSO_4$, Ag_2SO_4 and $FeSO_4$. In such a case there takes place on the lower hearth a sulphating reaction similar to that above described, and concurrently therewith a chloridizing action, common salt (NaCl) being added to chloridize the silver. The salt is fed to the fourth hearth in proper quantities through doors or any suitable form of automatic feeder. The temperature of the hearth on which the salt is introduced is from 850 to 1000° F., this being sufficient to cause the salt to react with the metallic constituents of the hot calcine. The salt chloridizes the silver present and that portion of the copper ($CuSO_4$), which may have escaped conversion into oxide on the upper floors. Other reactions will take place between the various products, the principal reactions identified with the chloridizing step of the process being as follows:

$$2\,Ag + 2\,NaCl + O = 2\,AgCl + Na_2O.$$
$$Ag_2S + 4\,O + 2\,NaCl = 2\,AgCl + Na_2SO_4.$$
$$Ag_2SO_4 + 2\,NaCl = 2\,AgCl + Na_2SO_4.$$
$$CuO + 2\,NaCl = CuCl_2 + Na_2O.$$
$$CuSO_4 + 2\,NaCl = CuCl_2 + Na_2SO_4.$$
$$FeSO_4 + 2\,NaCl = FeCl_2 + Na_2SO_4.$$
$$FeO + 2\,NaCl = FeCl_2 + Na_2O.$$
$$FeCl_2 + O = FeO + 2\,Cl.$$

The final product or calcine is cooled in any suitable ore cooler and subsequently leached with a solution containing 3 to 15% by weight of sulphuric acid and from 4 to 15% by weight of common salt. The dissolved metallic salt may be subsequently recovered by precipitation or any other method known to the art.

In most chloridizing-roasting processes, a certain percentage of the copper (usually as chloride) volatilizes. It is aimed to reduce volatilization to a minimum by the Laist process, but it is suggested that these copper fumes can be saved by leading the furnace gases to a suitable absorption tower or to Cottrell electric-precipitation apparatus, or both.

The charge to be roasted, in one instance, contained from 2.5 to 3% of sulphur and when it dropped from the third hearth to the fourth it still contained about 1% of sulphur. The finished calcine contained about 0.5% of sulphur, of which 0.1% was in the form of undecomposed sulphides, and 0.4% in the form of sulphates. When the calcine dropped from the third to the fourth hearth it contained about nine-tenths of the sulphur in the form of the undecomposed sulphide and one-tenth in the form of sulphate.

The decomposition of the sulphides by the oxidizing roast leaves but a small percentage of undecomposed sulphide to contend with in the chloridizing-and-sulphating hearths, the major portion in said hearths being probably silver sulphide. Thus the sulphur element as a fuel and heat generator is practically eliminated in the chloridizing hearth. The result is a chloridization with a minimum volatilization of copper chlorides.

The furnace shown in Fig. 2 covered by Mr. Laist's patent, No. 1,114,371, is an improvement on a previous construction (U. S. patent 1,070,490). The improved furnace is characterized by the presence of a muffle or combustion chamber interposed between the second and third hearth. The result obtained is a gradual and less intense heating of the ore and at the same time a better combustion of the gases from the fireboxes. The flow of the furnace gases is shown by the arrows.

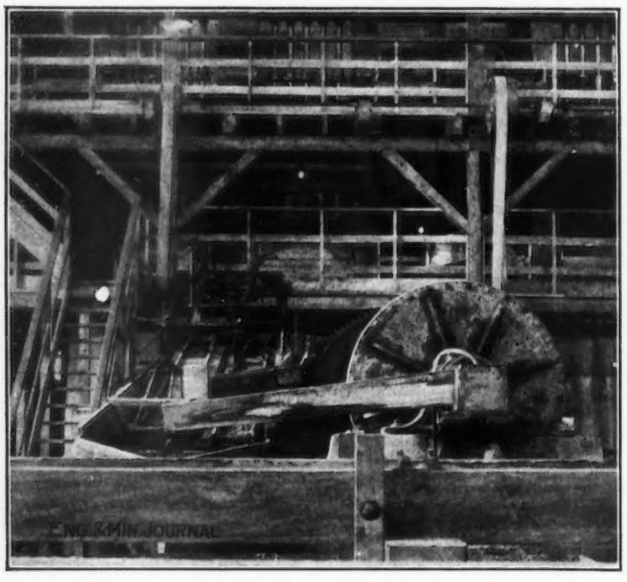
[At the January meeting of the New York section, A. I. M. E., it was stated that chloridizing roasting had been dispensed with at Anaconda and salt solution added in the leaching tanks with satisfactory results. In response to an inquiry on this point, Mr. Laist states: "After considerable experimentation, we decided to omit salt from the roasting furnaces. Under these conditions of course no chloridizing is done in the furnace, and there is also no volatilization of metals which means

about 6% when salt is present in the furnace. We obtain an extraction in our case of about 75% of the silver by maintaining salt in the leaching solution. The silver in the calcine is chloridized by the copper chlorides and the iron chlorides present in the leaching solution. When salt was added to the furnace the silver extraction ranged from 85 to 90%. In our case the amount of silver in the ore is so small, being only ½ oz. per ton, that the difference of 10 or 15% in silver recovery did not amount to enough in dollars and cents to balance the greater difficulty of operating the furnace when salt was fed into it."—EDITOR.]

Grinding in Closed Circuit

Tube mills and classifiers are arranged in closed circuit where an all-slime product is required. The classifier oversize is delivered to the tube mill for regrinding and the tube-mill discharge is sent immediately back to the classifier, where it is freed of slimes and the oversize again reground.

Most present-day arrangements of closed circuits are about as is the practice at the Hollinger mill, at Timmins, Ont. This arrangement is shown in the accompanying illustration. The tube-mill discharge, to which some



TUBE MILL AND CLASSIFIER IN CLOSED CIRCUIT AT HOLLINGER MILL

solution is added, is run directly to the classifier, while the oversize sand is delivered to the feed end of the mill through a scoop feeder which may be made of large enough diameter to account for the required lift. In this way the necessity for lifting or elevating machinery is avoided.

Recovery of Molybdenum

According to Frederick D. S. Robertson, of Toronto, Canada (U. S. pat. 1,118,150), molybdenum is best recovered by crushing the ores to about 8-mesh, preferably through rolls, as that preserves the flaky structure best. This ore is then exposed to a heat exceeding 790° C. in an atmosphere containing an excess of oxygen.

The trioxide is formed under these conditions, and is volatilized. A baghouse or other suitable arrangement is then provided for collecting the volatilized MoO_3. The charge must not be allowed to sinter during roasting. This may be done by adding silica or lime, according to nature of the gangue, to the ore before roasting. If necessary the trioxide may be further purified by redistillation.

Slater Process in Lake Superior Copper District

EDITORIAL CORRESPONDENCE

The Slater process for leaching copper ores is to be tried on a commercial scale in the Lake Superior copper district in the near future. The Pacific Coast rights for this process are controlled by the Western & International Precipitation Co., of Los Angeles, this company also being interested in the Cottrell process. Some experiments on a small scale have been made on some of the copper sands of upper Michigan, and the results have been sufficiently satisfactory to warrent the experiments being tried on a larger scale. It is expected that by the coming spring, a 10-ton plant will have been built at some point on the South Range in the Copper Country. This process has been described in the JOURNAL of Sept. 27, 1913. The men who are interested in the Copper Country project believe that the process can be used with profit in the Lake Superior district, but that at least, experiments on a 10-ton scale will bring defects and difficulties to light.

X-Ray Inspection of Castings

In the *General Electric Review* for January, 1915, is described the use of a Coolidge tube made for high-voltage X-ray work to examine the interior of a steel casting for blow holes. The casting in question was $\frac{9}{16}$ in. thick at the point examined and a two-minute exposure was sufficient to secure a radiograph. The plates taken all showed peculiar markings apparently indicating a cavity. The plate was then cut into and flaws were found as indicated by the plates.

It is suggested that we may some day take pictures of steel ingots to see where to crop. Certainly thin castings are no longer a sealed book.

Preparing Pyritiferous Blende for Magnetic Separation

In the preparation of blende for magnetic separation it is attempted to convert the pyrite into pyrrhotite. If the oxidation is not carried far enough, some pyrite is left unchanged and therefore nonmagnetic. If the oxidation is carried too far, some of the pyrrhotite is changed to nonmagnetic ferric oxide.

Gilbert Rigg of Palmerton, Penn., states that by roasting in a muffle or shaft without air at temperatures ranging from 600° to 800° C., all of the pyrite is converted to pyrrhotite, and none of the latter is oxidized (U. S. pat. 1,103,082). In this roasting it is only necessary to guard against fusion of the charge. The sulphur escapes in elemental form and can be condensed and recovered. This latter process is covered by U. S. pat. 1,103,081.

The Assayer and Chemist

Economy and Rapidity in Copper Titrations

By Edgar A. Slagle*

Comparisons of the results obtained by the electrolytic, iodate and iodide methods for the determination of copper which have appeared in the Journal from time to time have shown that the accuracy of the iodide method is beyond dispute. An objection to the iodide assay that has been raised is the use of an expensive chemical, potassium iodide, especially since the present war has greatly increased the price of this chemical.

The following will be found a simple and convenient method of recovering the iodine and consequently reducing the cost of the copper assays: Directly after the titrations are finished an excess of sodium thiosulphate and several grams of lead nitrate are added to the beaker. This precipitates all the iodine present in sodium and potassium iodide as lead iodide. The portion of iodine combined as cuprous iodide remains undisturbed so the total precipitate is composed of lead iodide and cuprous iodide. The contents of the beaker can then be transferred to a large jar. At intervals, after settling, the liquid can be siphoned off and the iodine salts disposed of to chemical houses.

Chemists who use the iodide method for copper assays usually employ it on account of its rapidity. This method can be appreciably shortened by avoiding the use of ammonia or sodium carbonate to neutralize the nitric acid and subsequent acidification with acetic acid in the following manner: After solution and removal of all nitrous fumes, by boiling, the solution is diluted to about 250 c.c. and about 15 to 20 c.c. of a saturated solution of zinc acetate added and the titration carried out as usual after addition of about 10 times the weight of copper present of potassium iodide. The end point with starch can be determined without difficulty, but will not remain permanent for more than five or 10 minutes.

*Chief chemist, Westminster Metal & Foundry Co., Westminster, Md.

Determination of Iron, Mercury and Arsenic in Sulphuric Acid

The following method was described by H. Nisjenson (*Chem.-Ztg.*, Sept. 29, 1914; abstr. *Journ. Soc. Chem. Ind.*, Nov. 30, 1914):

In an Erlenmeyer flask are placed 60 grams of pure zinc and 100 c.c. of sulphuric acid, freed from HNO_2 by heating, are added by means of a burette. The hydrogen is passed into a small Erlenmeyer flask, containing 1 c.c. of bromine, 100 c.c. of water, and a few drops of sulphuric acid. After about an hour and a half nearly all the zinc will be in solution. The rest of the zinc, which contains the mercury as an amalgam, is filtered, washed and dried. After being mixed with freshly burnt calcium oxide, it is placed in a porcelain crucible, covered with a weighed cover. The upper hollow of the cover is filled with cold water and the crucible is cautiously heated for 10 minutes; the cover is washed with alcohol, dried carefully, and weighed. The iron will be in the filtrate and is titrated with N/100 permanganate. The arsenic is absorbed as AsH_3 by the solution of bromine. The bromine is evaporated by heating the solution. The colorless liquid is reduced by boiling with Na_2SO_3, after which hydrochloric acid is added. The arsenic is titrated with a N/10 $KBrO_3$ solution, using indigo as an indicator. One cubic centimeter of $KBrO_3$ solution corresponds with 0.00375 gram As. This analysis of technical sulphuric acid can be done in about five hours.

The Ferrocyanide Determination of Zinc*

The method by titration in alkaline solution is the method recommended for use at Broken Hill for the estimation of zinc by titration with potassium ferrocyanide. The first modification for use with acid solutions was formally rejected.

Titration in Acid Solution

Weigh out 0.5 to 5 grams of ore in an 8-oz. beaker and dissolve in 10 c.c. concentrated nitric acid. When all red fumes have ceased add a few crystals of potassium chlorate and evaporate to hard dryness. [This does not seem superior to the common Western procedure of treating in a casserole with a saturated solution of potassium chlorate in strong nitric acid.—Editor.] Allow to cool, and then add 50 c.c. of hot water, 15 c.c. of ammonium hydrate (sp. gr. 0.88) and 7 grams of ammonium chloride, and boil on a sand bath for at least four minutes.

Filter and wash thoroughly with a 1% NH_4CL solution until the filtrate measures about 300 c.c. Add 2 grams sodium thiosulphate and one drop of methyl-orange solution. From a burette then add concentrated hydrochloric acid until just acid, then 5 c.c. in excess. Heat to 80° C. and titrate with potassium ferrocyanide, using a saturated solution of uranium acetate as an outside indicator. The end point is reached when one drop of solution and one drop of the acetate indicator give a faint chocolate color on a white spot plate.

Standardization of the K_4FeCy_6 Solution

Weigh out 0.3 gram of c.p. zinc oxide, previously ignited to redness and cooled in a dessicator, or 0.25 gram c.p. metallic zinc, and dissolve in 10 c.c. of hydrochloric acid. Dilute to about 200 c.c. with hot water, then add 15 c.c. ammonia water (sp. gr. 0.88) and 7 grams of ammonium chloride and proceed as given above for the assay.

*Excerpts from the report of the Assay Sub-Committee of the Australasian Institute of Mining Engineers (Broken Hill Branch), which investigated the methods used at Broken Hill, with a view to recommending a standard procedure.

Titration in Alkaline Solution

The potassium-ferrocyanide solution contains 32.3 grams of the pure salt per liter (1 c.c. = 0.01 gram zinc). A ferric-chloride solution containing in each liter 200 grams of cream-of-tartar and 2 c.c. of a neutral ferric-chloride solution carrying 10% iron is also used. This emulsion must be well shaken before using and 30 c.c. used for each assay, as specified below. The outside indicator is pure glacial (99-100%) acetic acid.

To standardize the solution, weigh out two lots of pure, freshly ignited zinc oxide, dissolve in about 5 c.c. of dilute nitric acid (1:4) and evaporate nearly to dryness. Dilute with 100 c.c. hot water, add 7 grams pure ammonium chloride and 15 c.c. of 0.88 ammonia, dilute to about 300 c.c. with hot 1% ammonium-chloride solution and add 30 c.c. of ferric-tartrate emulsion. Titrate at 70° C. with potassium ferro-cyanide solution, until one drop of the solution gives a faint blue color on a spot plate with the indicator.

The difference in weight of the two quantities of zinc taken, divided by the difference in the cubic centimeters of solution taken, is the absolute standard. The weight of zinc taken, subtracted from the cubic centimeters of ferrocyanide used multiplied by the absolute standard, is the "blank" to be deducted from all determinations.

The Assay

As no titration should require less than 2 c.c. nor over 25 c.c. of the ferrocyanide solution, weigh out 0.5, 1 or 2 grams of sample into an 8-oz. beaker. If sulphide, dissolve in 6 to 10 c.c. of strong nitric acid and boil. When red fumes cease, add 1 gram of chlorate and evaporate to complete dryness. This precipitates the manganese as oxide.

For roasted ores, oxides, etc., boil with 7 to 10 c.c. of strong hydrochloric acid, evaporate nearly to dryness and add 10 c.c. HNO_3. Boil until most of the acid is decomposed, then add a little powdered potassium chlorate and evaporate to complete dryness.

Cool, add 100 c.c. hot water, break up the mass with a rubber-tipped rod, and add 7 grams of ammonium chloride, 15 c.c. of 0.88 sp. gr. ammonia and about 0.5 gram sodium peroxide. Boil for a few minutes and filter off the precipitated iron, alumina and manganese. Redissolve the precipitate in the least necessary hydrochloric acid and reprecipitate. Wash the precipitate with boiling 1% ammonium-chloride solution until the bulk of the filtrate is about 300 c.c.

Add 30 c.c. of the ferric-tartrate emulsion and titrate at 70° C. with potassium ferrocyanide. If copper is found to be present, before adding the ferric tartrate emulsion make the solution just acid with hydrochloric acid, add 1 c.c. excess, and then about 20 grams of clean granulated lead (zinc free). Warm on the sand bath with occasional stirring until all the copper is precipitated, decant the liquid, wash several times by decantation, add 30 c.c. ferric-tartrate emulsion, 15 c.c. of 0.88 ammonia, and titrate, using the acetic-acid indicator on a spot plate.

It is advisable, when dissolving roasted and sintered ores, to rub with a little water first, to prevent adhesion.

With very low-grade ores the amount of ammonia present may prevent the precipitation of the zinc when titrating. In this case acetic acid is added until a precipitate forms, and the titration is then completed.

[In connection with any method of ferrocyanide titration it should be remembered that the zinc ferrocyanide precipitate is of constant composition only in case the ferrocyanide is in excess. To obtain the best results, therefore, the solution to be titrated should be divided into halves fairly closely, and one-half titrated. All except 1 or 2 c.c. of the second half of the solution should be added and the end point over-run with the ferrocyanide solution. Allow to stand a few seconds and add the last of the solution, finishing as accurately as possible.

Where many zinc determinations are run, c.p. ammonium chloride becomes a burdensome and apparently unnecessary item of expense, for the ordinary commercial sal ammoniac seems to answer perfectly.—Editor.]

The Assay of Tin Ores

A modification of Beringer's method of assay for tin ores is given by H. W. Hutchin (*Bull.* I. M. M., No. 113), which appears to be a decided improvement over the original. The author's experiments are omitted, and only his conclusions concerning the proper procedure are given.

The amount of tin ore taken is 2.24 grams (since the assay is reported in pounds per long ton). This is mixed with 2 grams of burnt lime and placed in an alundum crucible (porcelain and platinum are not so good), the bottom of which is covered with a thin layer of precipitated calcium carbonate, and the sides rubbed with the same material. The mixture is then ignited for 15 min. over a 5/8-in. Teclu burner or for 20 min. over a 5/8-in. bunsen. Since the reducing gases from the burner take an active part in the reaction, muffle ignition is not an equivalent. A porcelain crucible may be used by igniting 5 min. longer.

After ignition the charge is tipped out, and the remainder, largely calcium oxide, brushed out with a small brush. Used thus the crucible has a long life. The crucible should be supported so that the flame envelops it.

The crucible itself is a good indicator of the position; as supplied it is slightly tinged with iron oxide. If it is at the proper height in the flame it will burn white, but if too high in the cone of flame, the upper part will burn to its original color. After this ignition the residue is dissolved in dilute HCl, reduced with nickel, and treated as an ordinary assay.

In the discussion (*Bull.* I. M. M. No. 115), it was pointed out that it was important to examine the solution following a bisulphate fusion for tin. It was possible, in any unknown ore, that some tin occurred in such form as to be rendered soluble by this fusion.

Analysis of Copper-Tin-Silicon Alloys

In speaking of the analysis of copper-tin-silicon alloys, E. D. Koepping (*Journ. Ind. Eng. Chem.*, August, 1914) calls attention to the fact that they are insoluble in nitric acid and recommends that they be dissolved by boiling 0.5 gram of the alloy with 15 c.c. HCl and 5 c.c. HNO_3, then after complete decomposition, add 20 c.c concentrated H_2SO_4 and boil to copious fumes.

Correspondence and Discussion

Electric Smelting for Southeastern Alaska

I am inclined to take issue with the statement in the JOURNAL of Dec. 26, 1914, of electric copper smelting being an unknown art. It may be an art not practiced at the present time in America, but is not this because the conditions for its successful operation have not been thoroughly known? I would refer you to an article read at the August meeting of the A. I. M. E. by Lyon and Keeney and published by permission of the director of the U. S. Bureau of Mines.

In their introduction they did not claim the electric furnace would displace the combustion furnace but would be used for the treatment of ore deposits which are situated in regions where fuel is scarce and costly and where hydro-electric power is comparatively cheap, or for use in a district remote from railroad transportation facilities, and where there are deposits of sufficient value to warrant their being worked, but which, due to the cost of getting coke or oil to a smeltery, have remained unworked; and where, on the other hand, there is plenty of water power which can be developed at reasonable cost for production of electric power, by the use of which smelting the ores in an electric furnace with subsequent bessemerization, if necessary, a concentrated product may be obtained which can easily stand the transportation charges.

Or, comparatively speaking, the transportation facilities may be all right but the cost of fuel be too great to permit the ordinary methods of smelting, whereas, on the other hand, hydro-electric power can be developed in the district at a low cost and ores could be smelted in an electric furnace that would make their treatment possible. I believe the latter more nearly states the existing conditions in southeastern Alaska. At the present time good foundry coke costs in excess of $20 per ton in Juneau, while small shipments in sacks in the past have cost approximately $30 per ton. Compare this with coke selling in our Eastern markets for $2 per ton and less.

While the whole of southeastern Alaska, a network of mountainous islands adjoining a jagged mainland, is subjected to an extremely high rainfall, at Ketchikan the precipitation for 1913, according to government records, was 158 in., or over 13 ft. of water falling in one year. By far the cheapest all-year power of any place in the United States may be obtained in this section of Alaska. I refer to the Speel River power project where, according to E. P. Kennedy, late assistant superintendent of the Alaska Treadwell Gold Mines, hydro-electric power can be developed at tidewater in blocks of 10,000 hp. for a capital cost per horsepower of $27.95, or allowing 8% for interest and depreciation, $3.43 per horsepower-year. These are figures published in *Western Engineering*, January, 1914.

Freight on ore from any port of southeastern Alaska to this power should not exceed $1 per ton. Quoting again from the aforementioned A. I. M. E.:

"The electric smelting of copper ores is nothing more than the substitution of electric heat for the heat derived from the combustion of carbon. Inasmuch as the carbon which is used either in the reverberatory furnace or in the blast furnace plays no important part in the necessary reactions which take place in these furnaces, there is no reason—metallurgically—why electric heat may not be substituted for the heat derived from the combustion of carbon. In fact, as we have tried to point out, in some cases the reactions would take place to better advantage in neutral atmosphere of the electric furnace than in the reducing or partially reducing atmosphere of the combustion furnace. Therefore, as to whether the electric furnace would be used for the smelting of copper ores would largely depend, so far as we are able to make out at the present time, upon the relative cost of coke and electric power. As the use of the electric furnace is not advocated as a competitor of the combustion furnace, but as a substitute for it, in those localities where it is not advisable because of the high cost of fuel, we see no reason why the electric furnace may not be developed as a substitute for the combustion furnace, where the conditions are such as to warrant its use, especially in the treatment of copper-bearing ores."

Although your editorial remark as to electric copper smelting being an unknown art is no doubt true so far as actual practice in this country is concerned, I maintain that it is not a lost art; that it is being practiced in Norway at the present day, and is extremely applicable to this section of Alaska. Your remarks regarding our government are, of course, your own private opinions and not subject to dispute.

F. C. FARNHAM.

[Our statement that electric copper smelting is an unknown art was not a matter of opinion but of fact. Jules Verne graphically pictured the submarine, but it was many years before the submarine became a real thing. Electric copper smelting may look easy, but we prophesy many failures before it is developed into an art. Up to the present time there has been scarcely any experimenting on this line.—EDITOR.]

Magnetic Separation of Tin-Wolfram-Bismuth Ores

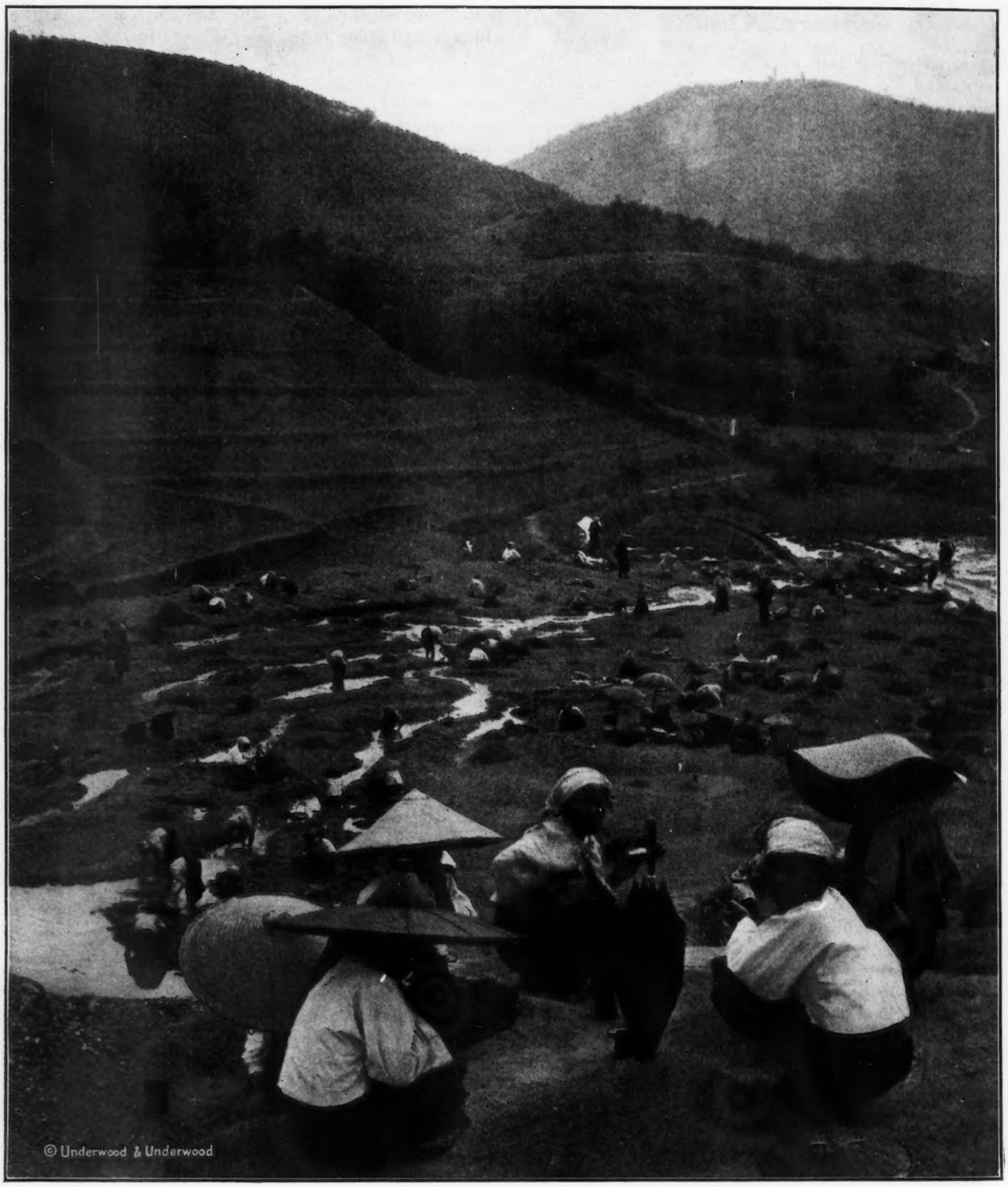
On p. 486 of the JOURNAL of Sept. 12, 1914, is a short article in regard to the treatment of tin-wolfram-bismuth ores by a magnetic process.

In this connection I wish to call your attention to the fact that various plants for the separation of tin-wolfram-bismuth ores with Ullrich magnetic separators have been built and are giving excellent results. As a rule a 2- or 4-pole separator with belt conveyor for feeding the crude ore is provided. The yield which we have been able to obtain has been as high as: Wolfram, 97.8%; tin, tin, 98.1; bismuth, 86.9 per cent.

FELIX A. VOGEL.

New York, Jan. 27, 1915.

Photographs from the Field

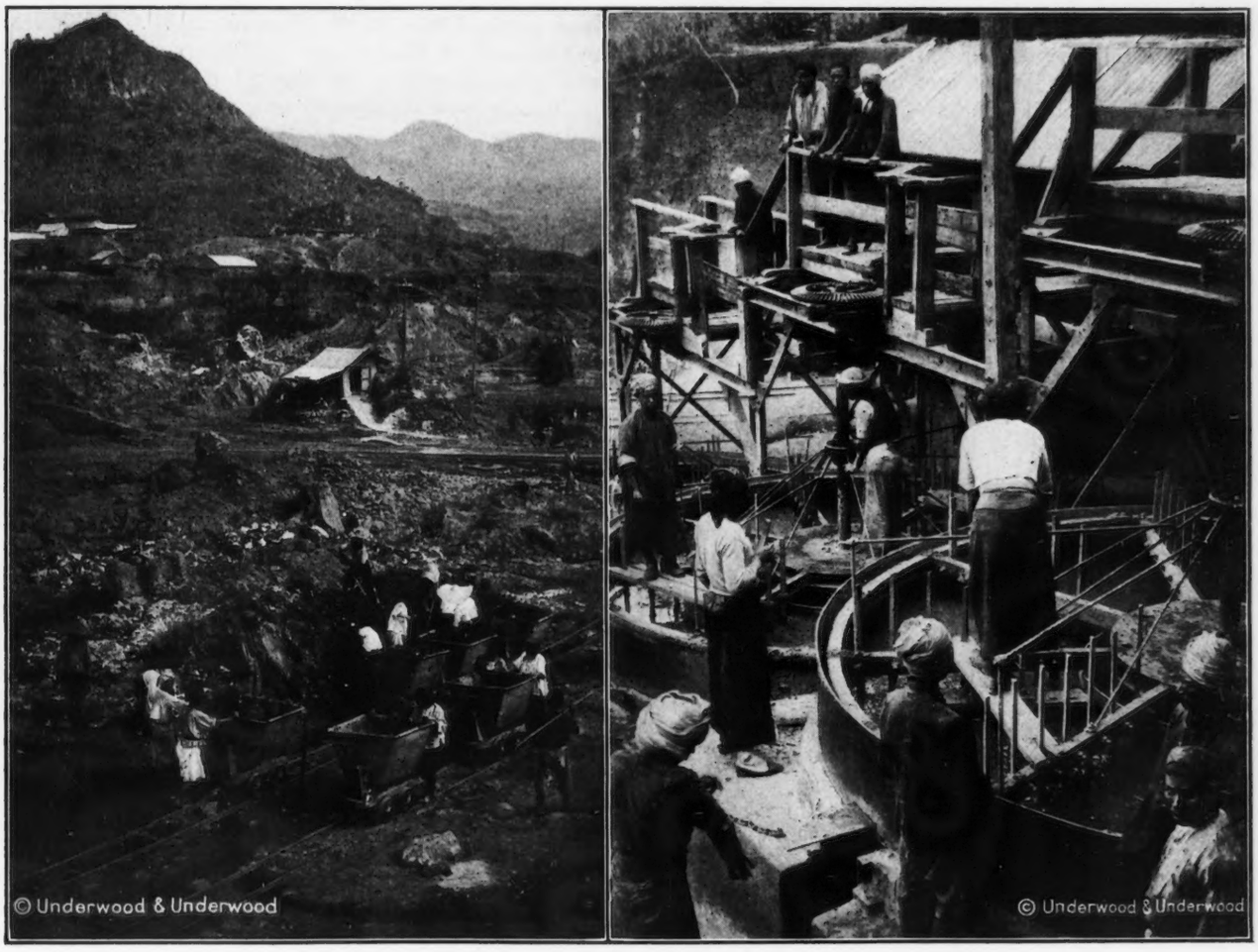


RUBY MINING IN BURMA

The native system; hand-sifting and washing the stream beds. This is the richest ruby district in the world and provides most of the finest stones

THE LEADVILLE DISTRICT, COLO.

California Gulch, showing the Minnie, Col. Sellers, Moyer and North Moyer mines, Iron Silver offices, and surrounding district as it looks today



RUBY MINING IN BURMA

European methods applied to the district. At the Mogok mines the gravel is loaded in cars, which are delivered to a mill employing mechanical cleaning and washing machines

Improvements at Trail, B. C.

Extensive improvements have been in progress for several years at the Trail smelting works of the Consolidated Mining & Smelting Co. of Canada. The expenditures on improvements during the last fiscal year were $482,-134. The objects of these alterations have been: (1) To increase the capacity of the plant; (2) to increase recoveries; (3) to decrease cost of operation.

The lead-smelting plant has been practically rebuilt, the new construction including three new lead blast furnaces; extensions to building; cranes for handling the forehearths and byproducts, such as matte; two Wedge roasters; conveyors and automatic scales for handling the ore from storage to the roasters, and for handling the preroasted product from roasters to sintering pots; a Cottrell plant for clearing the blast-furnace gases of lead fumes; new charge cars and some small equipment for the lead sampling mill.

General Manager R. H. Stewart states in the report that the lead plant formerly handled high-grade clean concentrates, comparatively low in sulphur and free from zinc, supplied mainly by the St. Eugene mine. Following the exhaustion of this mine, it was necessary to replace the tonnage to a large extent with ore of lower grade and of a much more refractory nature, largely from the Sullivan mine; this charge carried more sulphur and required greater capacity for roasting and furnacing in order to produce an equal tonnage of lead. In the old roasting plant, the seven Godfrey roasters had a daily capacity of only 25 tons each of Sullivan ore; the Wedge roasters just installed each have a capacity of from 85 to 95 tons per day, and cost to operate about 50c. per ton less, the saving being mainly in fuel and firing. The substitution of conveyors and mechanical equipments for handling the ore and the product of the Heberlein pot plant also reduced operating costs. The building of new lead blast furnaces was considered necessary on account of the condition of the old ones, and in rebuilding it was decided to place them farther from the copper plant, so as to permit any necessary extensions to the latter, and also to allow for better charging arrangements. The new flues and Cottrell plant are now saving about eight tons per day of material high in lead, a considerable portion of which was previously lost.

In the copper-smelting department, the improvements consisted of: Rebuilding three of the five blast furnaces and increasing the dimensions of two of them; building a new smoke-stack; repairs to the flues; installaion of a crane in the furnace building, and rebuilding the launders to the slag dump.

In rebuilding, two of the furnaces were increased in size from 300 to 420 in. in length, and from 42 in. to 50 in. in width at the tuyeres. The enlarged furnaces so far show an increase in smelting capacity of from 60 to 80%, with proportionate decrease in cost of labor and some reduction in amount of coke required.

Other improvements include the installation of an additional blower having a capacity of 40,000 cu.ft. of air per minute; rebuilding the fire-protection system; stacks and tunnels for recovering ore from storage and extra locomotives for charging the furnaces.

General Manager Stewart expects that the changes made in the smelting works during the last two years will result in sufficient saving in cost of operations and recoveries to pay for the expenditure within the next two or three years.

Russian Chemical Industry Possibilities

With the idea of extending the chemical industry of the country a number of Russian technical societies have been turning their attention to its resources in raw materials for the production of some of the finer chemicals, says the *Chemical Trade Journal,* Jan. 2. 1915. They find that the quicksilver industry, which has been allowed to lapse, could be revived by exploiting the cinnabar deposits known to exist in Daghestan, Ter, Kuban, Trans-Baikal, in the Urals, Nerchinsk and Ekaterinoslaff. As to lead ore, this is found in the Caucasus, in the Don, Altai and Nerchinsk. It is a slow-developing industry in Russia, where only about 80,000 poods a year of the metal are produced, and over 3,000,000 poods are imported. The production of silver is negligible.

Zinc, however, is produced in considerable quantities in Poland. It is found also in the Caucasus, in Finland and in the Donetz and Nerchinsk districts. Russia produces about one-third of her consumption of zinc, the rest being obtained from Germany. Bismuth is found in Finland, Trans-Baikal, and Eastern Siberia, but it is imported almost entirely. Arsenic in combination is found in the Urals, in the government of Orenburg, in the Caucasus, in Finland and in Eastern Siberia. Magnesia salt is found in the Zlatoust mining district, but this too, is mostly imported—to the extent of 450,000 poods a year.

There is abundance of material in Russia for the production of phosphates; but foreign factories can produce this article too cheaply for Russia to compete even in her own market. Manganese exists in immense quantities in the Russian Caucasian territories as well as in South-European Russia at Nikopol, and in less important quantities in the Urals, etc. Most of this product is exported. It is maintained that with such an abundance of raw material the volume of Russia's importations of some of the finer chemicals should be much reduced.

It is stated that at a recent meeting of the Russian Technical Association, the announcement was made that a group of Petrograd capitalists is contemplating the erection of a factory for the production of chlorate of potash.

The Rivadavia Oil Field, Argentina

Near Comodoro Rivadavia, in the Territory of Chubut, Argentina, the oil field is under exploitation both by the national government and by four private companies. The government has reserved a zone of 5000 hectares for exploration and has put down 15 wells, of which nine are productive and two are nearly finished, according to information received from the Direccion General de Minas, Geologia e Hidrologia. The four private companies working in this region are the Cia. Argentina de Perforaciones Sistema Raky, Cia. Especial de Perforaciones, Sindicato Petrolífero Pozo de Menendez, and Cia. de Petróleo de Comodoro Rivadavia. The first named company has two wells in process of completion, one of which has reached

the petroleum horizon. The second company has four wells, one of which has reached the petroliferous strata. The other two companies have one well each, but neither of these has yet arrived at the petroleum horizon.

Up to the present, only the government has commenced the exploitation of the Rivadavia deposits in a systematic manner, having already various important installations and having constructed at Comodoro Rivadavia a wharf and tanks of large capacity. As means of transport it employs two tank steamers.

In the territory of Neuquén there have been some explorations for petroleum, but up to the present none of these has reached the petroliferous strata, the existence of which has been determined by the geologic studies of the governmental officials.

All-Northwest Smoker

The annual All-Northwest smoker of the Mines Society of the University of Washington was held at the Men's Building on the evening of Jan. 15. The Mines Society, which is affiliated with the American Institute of Mining Engineers, is composed of all upperclassmen of the College of Mines and three students chosen from the Sophomore class. All members of the mining faculty are honorary members of the Society. Meetings are held twice a month, at which the students discuss their experiences in mining work. Smokers, which outside mining men are invited to attend and at which they are often called on to talk, are given from time to time.

The All-Northwest smoker is held in January of each year for the especial benefit of the short-course men, who commence work in January and continue until April. Music, talks, boxing and wrestling bouts, and refreshments play a large part in the program. Considerable time is devoted to "mixing" and getting acquainted, with excellent results.

At the 1915 meeting there were 66 present. The talk of welcome (all formalities, including "speeches" and "addresses," are strictly taboo) was made by Villeroy Gleason, president of the Society, who explained that the fundamental purpose of the smoker was to make each and every visitor and "short horn" feel that he was "one of the gang." Talks by visitors and members of the faculty followed, punctuated by bouts and refreshments. Among the mining men who spoke were the following: Ralph Bliss, Charles Simonstad, Wm. R. Hocking, C. L. Anderson, and George W. Otterson.

One of the interesting features of the entertainment was an oil well and derrick, symbolic of the wild-cat oil boom to which Seattle and the Northwest has recently been treated. The fact that the product of the well was more suitable for internal lubrication than for fuel purposes did not detract from the enthusiasm of those present when the ceremony of uncapping was performed.

Cripple Creek Metallurgy

A contributor calls attention to an error which crept into the review of mining in Colorado, in the statistical issue of the JOURNAL. It refers to the roasting and chlorination of the high-grade ores of Cripple Creek, whereas it is well known that these ores are smelted, and the low-grade material cyanided. There are no operating chlorination mills in the district.

NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

BRIQUETS—Process for the Manufacture of Briquets from Suitable Briquet Materials. Carl Fohr, Munich, Germany. (U. S. No. 1,123,719; Jan. 5, 1915.)

CARNOTITE—Method of Treating Complex Carnotite Ores. Charles W. Danforth, Youngstown, Ohio, William P. Samuels, New Castle, Penn., and William T. Martersteck, Youngstown, Ohio. (U. S. No. 1,126,182; Jan. 26, 1915.)

CASTING METALS of High Melting-Point. Augustin Leon Jean Queneau, Philadelphia, Penn., assignor, by mesne assignments, to Samuel P. Wetherill, Edgewater Park, N. J. (U. S. No. 1,126,079; Jan. 26, 1915.)

COPPER—Reinforced Copper and Process of Making Same. William Marshall Page, Ridley Park, Penn. (U. S. Nos. 1,125,162 and 1,125,163; Jan. 19, 1915.)

CRUSHING—Tube Mill. David H. Atkins, San Francisco, Calif., assignor to Atkins, Kroll & Co., San Francisco, Calif. (U. S. No. 1,125,921; Jan. 26, 1915.)

DRILL—Mine-Drill Support. Howard P. Corsa, Bingham Cañon, Utah. (U. S. No. 1,125,480; Jan. 19, 1915.)

DRILL-BIT-RETAINING DEVICE. George H. Gilman, Claremont, N. H., assignor to Sullivan Machinery Co., Boston, Mass. (U. S. No. 1,126,628; Jan. 26, 1915.)

DRILLING—Apparatus for Handling Casing in Drilling Wells. Earle Derby, Coalinga, and Henry B. Truett, San Francisco, Calif. (U. S. No. 1,121,718; Dec. 22, 1914.)

DRILLS—Dust Collector for Rock Drills. Emmet F. Galligan, Idaho Springs, Colo., assignor of one-half to Henry E. Woodward, Denver, Colo., and one-fourth to William H. Galligan, Idaho Springs, Colo. (U. S. No. 1,124,605; Jan. 12, 1915.)

EXCAVATING MACHINES—Dipper Front. Ellison Edward Vanderhoef, Ruth, Nev., and Frank E. Johnson, Salt Lake City, Utah, assignors to Edgar Allen American Manganese Steel Co., Augusta, Me. (U. S. No. 126,319; Jan. 26, 1915.)

FILTERING PAN. Walter E. Trent, Reno, Nev. (U. S. No. 1, 125,769; Jan. 19, 1915.)

FLOTATION—Ore-Concentrating Apparatus. John M. Callow, Salt Lake City, Utah, assignor to Metals Recovery Co., Augusta, Me. (U. S. No. 1,124,853; Jan. 12, 1915.)

FLOTATION—Ore-Separatory Apparatus. John M. Callow and David J. Kelly, Salt Lake City, Utah, assignors to Metals Recovery Co., Augusta, Me. (U. S. No. 1,124,855; Jan. 12, 1915.)

FLOTATION PROCESS — Process of Concentrating Ores. John M. Callow, Salt Lake City, Utah, assignor to Metals Recovery Co., Augusta, Me. (U. S. No. 1,125,897; Jan. 19, 1915.)

FURNACE LININGS—Process of Forming and Repairing the Linings of Furnaces. Alfred Schwarz, New York, N. Y., assignor to New York Cement Gun Co., New York, N. Y. (U. S. No. 1,125,741; Jan. 19, 1915.)

GOLD-SAVING APPARATUS. Isaac Anderson, Lawndale, Calif., assignor to Lawndale Utility Manufacturing Co., Lawndale, Calif. (U. S. No. 1,125,631; Jan. 19, 1915.)

GRINDING MILL. Raymond Nicely Bailey, Muncy, Penn. (U. S. No. 1,123,217; Jan. 5, 1915.)

INGOT IRON—Process for Improving the Properties of Ingot Iron and the Like. Hans Goldschmidt and Hans Biewend, Essen-on-the-Ruhr, Germany, assignors to Goldschmidt Thermit Co., New York, N. Y. (U. S. No. 1,122,272; Dec. 29, 1914.)

MIXING DRUM—Rotary Mixing Drum. John M. Callow, Salt Lake City, Utah, assignor to Metals Recovery Co., Augusta, Me. (U. S. No. 1,124,854; Jan. 12, 1915.)

ORE-BELT EDGER. Albert W. Harp, Angels Camp, Calif. (U. S. No. 1,126,456; Jan. 26, 1915.)

ORE-ROASTING FURNACE. Emile Bracq, Lens, France. (U. S. No. 1,125,949; Jan. 26, 1915.)

PHOSPHORIC ACID—Process for Rendering Available the Phosphoric Acid in Phosphate Rocks. Alfred Hutchinson Cowles, Sewaren, N. J., assignor to The Electric Smelting & Aluminum Co., Sewaren, N. J. (U. S. N. 1,126,408; Jan. 26, 1915.)

PLATINUM—Process of Recovering Native Platinum Metals. Robert E. Lyons, Bloomington, Ind. (U. S. No. 1,126,646; Jan. 26, 1915.)

POTASSIUM—Process of Extracting Potassium from Flue Dust. Samuel Peacock, Philadelphia, Penn., assignor to International Agricultural Corporation, New York, N. Y. (U. S. No. 1,124,798; Jan. 12, 1915.)

SALT—Apparatus for the Manufacture of Salt. Herman Frasch, Cleveland, Ohio, assignor to United Salt Co., Cleveland, Ohio. (U. S. No. 1,125,998; Jan. 26, 1915.)

SCREEN or Separator. Thomas Leggett Sturtevant, Quincy, Mass., assignor to Sturtevant Mill Co. (U. S. No. 1,125,762; Jan. 19, 1915.)

SINTERING APPARATUS. Stephen Arthur Krom, Birmingham, Ala. (U. S. No. 1,125,125; Jan. 19, 1915.)

SMELTING FURNACE. Thomas M. Kekich, Aire Libre, Mexico, assignor of one-half to Carl Hanssen, Aire Libre, Mexico. (U. S. No. 1,126,028; Jan. 26, 1915.)

TIN—Process for Electrolytically Refining Tin. Georges Michaud and Eugene Delasson, Montreuil, France. (U. S. No. 1,124,315; Jan. 12, 1915.)

ZINC—Improvements in or Relating to the Separation of Zinc from Sulphide Ores. H. T. Durant, London, Eng. (Brit. No. 21,581 of 1913.)

ZINC LYES—Treatment of Zinc Lyes. Wilhelm Buddeus, Charlottenburg, Germany. (U. S. No. 1,120,683; Dec. 15, 1914.)

Editorials

The Kinds of Spelter

The unusually large demand for spelter of superior quality that has developed since the outbreak of the war has drawn out a good deal of inquiry about the kinds of spelter that outrank the main staple, which in the United States is known as "prime western," this being equivalent to the "good ordinary brands" of the European markets. The bulk of the production of virgin spelter, both in America and in Europe, consists of the prime western and G.O.B.'s. The production of all other kinds is relatively small. No specific data of the production of the several kinds of spelter can be given, for the reason that no statistics bearing upon this subject have ever been collected.

In the United States four kinds of virgin spelter are recognized and have been officially defined by the American Society for Testing Materials. These are: high grade, intermediate, brass special, and prime western The official distinctions are as follows:

KINDS OF SPELTER

Kind	Pb.	Fe	Cd	Total Not Over
A. High grade*	0.07	0.03	0.05	0.10
B. Intermediate*	0.20	0.03	0.05	0.50
C. Brass special*	0.75	0.04	0.75	1.20
D. Prime Western	1.50	0.08	...	...

*To be free from aluminum.

Besides the virgin spelters there are the kinds of the metal that are obtained by remelting scrap, resmelting dross, etc. Remelted spelter is sometimes called "hard spelter" and is apt to be impure from the solder and other metallic substances adhering to the scrap, the mere remelting not being a refining process, except for the separation of excess lead and the elimination of dirt, oxides, etc., in skimming. Spelter produced by resmelting (redistilling) dross, scrap, etc., may be of good grade, even of high grade, according to the care and skill of the smelter.

The production of the superior grades of spelter is chiefly a matter of the ore employed, which must be free, or nearly free, from lead; but besides that there must be special care in the smelting process, particularly to avoid contamination of the spelter by iron. The commonest impurity of zinc ores is lead, and lead being volatile a certain proportion inevitably goes over with the zinc and condenses with the spelter. If lead-bearing ores are smelted it is impossible to produce the highest grades of spelter by a single distillation, at least not in any way that would be economical from the standpoint of zinc extraction.

Thus it happens that the highest grade of spelter is made from the willemite ore of New Jersey. Previous to the war a considerable tonnage of that ore was regularly exported to Belgium and Germany and used for the manufacture of high-grade spelter there. With the outbreak of the war exports of this ore ceased. The extinguishment of the European supply is one of the causes creating the recent unusual demand upon American smelters.

Even in ordinary times, the price commanded by high-grade spelter is so much above that realized for prime western, that to all intents and purposes it is a different metal. Normally the premium has run anywhere from 2@4c. per lb., while the premium for intermediate spelters has been usually from 1@2c. per lb. Writing in 1912, however, it was remarked that "the supply of high-grade spelter could no doubt be greatly increased if there were need for it, and prospective competitors in this market would find it hazardous to reckon upon the full premium now realized." In the exceptional conditions resulting from the war, the ordinary premiums increased. Thus, we reported on Jan. 13 that high-grade spelter was then worth about 10c. per lb. New York, while intermediates were selling for 7½@8½c., basis St. Louis, and brass specials at 6¼@6¾c. when ordinary prime western spelter was selling at about 5⅞c. St. Louis. We heard of sales of high grade at 11@12c. Since then the prices for all of the specials have gone up to extravagant figures, and consumers have been willing to pay a premium for brands of prime western that are a little superior to the ordinary but yet are inferior to the brass specials as officially classified.

High-grade spelter also is made from the zinc blende of the Holston River district of Tennessee. Intermediate spelter is made from the same ore, and also from specially selected Joplin ores. In these cases it is chiefly the excellence of the ore that determines the superiority of the spelter.

High-grade or intermediate spelter may, however, be made from base ores by hydrometallurgical treatment and electrolytic precipitation. Such spelter is regularly produced in small quantity at Winnington, in England, and it is contemplated that some may be produced in California. However, save for the works at Winnington, the production of electrolytic spelter has not yet passed beyond the experimental stage.

Although the production of high-grade and intermediate spelters is chiefly dependent upon the kind of ore used, such spelters may be made from inferior products by refining, two methods of refining being available, viz., electrolysis and redistillation. The only question to be answered is, Will the added value offset the cost? And, naturally, the answer may be different in different parts of the world.

Electrolytic refining was tried in Upper Silesia upward of 20 years ago, the process being analogous to the electrolytic refining of crude copper. As tried in Upper Silesia, it was not found profitable, and so far as we are aware there has been no subsequent trial anywhere. Redistillation, on the other hand, is a process regularly employed. With the exercise of sufficient care, high-grade spelter may be made out of scrap and junk, just as pure water may be distilled from brine. Certain American brands of high reputation have had such an origin. Similarly, may prime-western spelter be converted into high-grade, but when this has been tried there has not been found to be any profit in the operation. There is not only the cost

of the operation itself, but also the loss of zinc experienced in the course of it. In Norway and Sweden, however, a considerable quantity of high-grade spelter is produced from impure spelter by redistillation in the electric furnace.

There are some who hold that high-grade spelter made in any other way than by direct distillation from ore is not quite equal to the latter although the two may be identical so far as the ordinary chemical analysis shows. One explanation of this idea is that the high-grade spelter derived from certain ores may contain infinitesimal quantities of rare elements, not commonly determined, which may give it superior toughness or other desirable qualities. So far as we are aware neither the claim nor the explanation has been positively demonstrated.

Brass-special and prime-western spelters are made from the same ores and depend merely upon keeping separate one of the "draws" of metal. In American smelting practice the spelter is commonly drawn from the condensers of the distillation furnace three times during the 24 hours of the distillation. The first draw gives metal distilled at the lowest temperature and consequently lowest in lead and iron. In ordinary times the premium for brass specials is small, say 0.05 to 0.10c., sometimes rising to 0.25c. and sometimes being *nil*. When it is small many smelters do not take the trouble to keep their draws separate, letting their whole product go as prime western. At present they are, of course, making as much of it as they can.

The Rise in Spelter

It has been the invariable experience for decades that whenever the price for spelter has risen above 7c. per lb., this has eventually proved to be a calamity for the industry. No matter what may be the immediate profits of the miners of ore and the smelters of spelter, the losses they experience later and the penalties they pay outweigh their previous profits. There is scarcely anybody of long and conservative experience in the smelting business who is not of this opinion now and who does not deprecate the sensational and extravagant rise that has recently occurred in this metal.

The explanation of the rise is simple enough. By the end of 1914 the stock in the hands of smelters had been reduced to a figure that was small in comparison with the middle of the year, although according to the ideas and standards of only two or three years ago, it was still large. During January the demand exhausted this stock and the smelters became practically sold out, not only for immediate delivery but also for what is normally called prompt delivery. In these circumstances a rise in price was natural, but that it should have been carried out of bounds was due to the fright experienced by consumers.

There has been talk about a corner in the metal, suspicion that there are concealed stocks and charges of manipulation. There is no good reason to believe anything of that sort, and the sooner consumers disabuse their minds of such ideas, the better off they will be. The leading smelting interests have stated repeatedly that they were sold out. Assuming that to be the case, and it ought to be so assumed, there is no use in consumers frantically bidding up the price against each other. If there were concealed stocks they might hope to pry them out, and eventually would do so, of course, but the bidding up of the price to 7½c., St. Louis, has failed to loosen any hidden stocks and probably there never were any, at least not in any quantity sufficient to sway the market.

Of course it is to be remarked that English and American buyers have been bidding up the market against each other. If the buyers would regain their senses and withdraw from the market, they would probably find that they can get as much spelter a cent a pound lower, as they can now. The present situation is, of course, bringing into use all of the idle capacity that can quickly be put into commission. There is, however, so much uncertainty in the situation that the owners of the moribund works in Kansas consider it hazardous to restock them with ore at present prices, and put them into commission on the basis of conditions that are likely to be ephemeral. In the meanwhile, smelters who have sold out all the spelter that they expect to make up to the end of March find it difficult to sell April and later deliveries even at considerable concessions in price.

The Chloridizing-Leaching Practice at Park City

The article by Glenn A. Keep, begun in this issue, presents some interesting details of the new chloridizing-leaching practice at The Mines Operating mill in Utah. The new mills at Park City and elsewhere in Utah, while not applying any new chemical reactions, have made such improvements in roasting and in other details as to constitute a new practice, though it can hardly be designated as a new process.

The improvements in the process today permit the handling of material formerly discarded by the Ontario mine as too low in grade for chloridizing and thiosulphate leaching. While changes have been made in many phases of the practice, the most striking development is in the chloridizing. The blast roasting of a deep, moist charge has brought about a great improvement in the process of chloridization. Not only has the chloridizing been accomplished more efficiently but loss by volatilization has been reduced practically to zero. Concurrent with this has been the improvement of the roasting apparatus itself, thereby greatly reducing the cost of the process. Mr. Keep's paper abounds in interesting information regarding the operation and technical control of the process; the practice is probably not yet developed to its highest state, and there are many points on which further information will be desired. The Park City practice, however, is an important metallurgical accomplishment, since it has taken low-grade complex mine filling of no value in former days and is making therefrom a profitable enterprise. While the practice is apparently simple and capable of being applied in small units, operators elsewhere must exercise the usual care in the adoption of the new practice. Not all districts, which have similar ores, have the surrounding conditions that make this process applicable at Park City.

Society Meeting Program

The light-hearted manner in which society secretaries juggle with the program is such as to call forth great admiration at their efficiency in the use of time, and curses at some other phases of the subject. No doubt it is a great saving of the time of those present, on suddenly discovering that Tuesday evening's program is 30 minutes

shorter than was anticipated, if Thomas Smith can be found to give his paper on openhearth steel practice, which was originally billed for Wednesday morning.

But the feelings of two pilgrims who catch the seven o'clock train from Philadelphia to New York on Wednesday morning in order to hear Mr. Smith speak, and arrive to find James Brown preparing to speak on the latest developments in cyanide practice, would, if entered in the Society minutes, cause that volume to be unmailable. Similarly it does no lasting good to any society, however well it may look in the preliminary announcements, to bill highly instructive looking titles, and have the papers withdrawn by advice of counsel. Here again, the policy may lead to a considerable expenditure of time and money in the effort to hear a paper which has been withdrawn.

BY THE WAY

Our attention recently fell upon the prospectus of a GRQ promoter who promised to make all his suckers wealthy out of the dividends to be derived from a molybdenum mine. The production of molybdenite is a nice little business, but it is not big enough to make any one man rich, much less a bunch of stockholders. Molybdenite ore realizes prices that to the uninformed appear to be fabulous, but the total volume of transactions amounts to only a few tons. A correspondent who is very practically engaged in the molybdenum business made the following illuminating remarks: "A few lots of selected molybdenite concentrates were sold in 1914 in small quantities at prices above $1 per lb. of MoS_2 contents. Indeed one lot of one ton realized $1.50 per lb. This was an emergency sale, and when it became known naturally caused many small producers to have visions of great wealth, and many of them raised the price of their prospects in proportion. In my opinion, the very high prices will give the owners temporary happiness, which will not be realized upon a cash basis. Eventually this mineral will become much better known commercially, most people will then be able to spell it correctly, and those of us who are more familiar with it will not, on account of uncertain supply and treatment problems, be compelled occasionally to allude to it as molybdedamite."

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There is a faint similarity between following up a report of a "bonanza strike" and running down a reference upon some technical subject. The practical miner hears that in such and such a district a good vein of ore has been found or that someone has panned rich gravel on a tributary of a certain river. He often spends considerable of his time and energy and more or less of his money in following up such a clue, only to meet with disappointment. On the other hand, one may find in the text or in a footnote of some article a rumor that more information on a subject may be found in such and such a publication on page so and so. When one is anxious to cover a subject very thoroughly it is well to leave no stone unturned. You are studying, let us say, the uses of copper in combination with other metals and you note that some author mentions that you will find some interesting data in J. B. 627-1895. That is equivalent to telling some old placer miner and stampede-runner that in the valley of the seventh tributary of the East Fork of the S. J. River may be found gravel running several ounces to the pan, and then skipping off so that he cannot question you further. If he follows up the hint, he will have a number of S. J. rivers to choose from. He might worm out the information from some friends of yours that S. J. means St. John, and he may eliminate several St. John rivers, for geological or other reasons. Picture his disgust when he eventually learns that you meant the *San Juan* River, and the *west,* instead of the *east* fork, in the same place where he prospected summer before last with but moderate success. How interesting, then, after being told that J. B. means "Jahrbuch," and looking up "Jahrbuch this" and "Jahrbuch that," to find that the reference J. B. 627-1895 is a sort of cryptographic way of referring to "Jahresbericht über die Fortschritte der Chemie," part 1 for the year 1895, p. 627, and to perceive that the matter is merely an incomplete abstract of an article which you have previously studied in great detail. On the whole, the practical miner has the best of it; for he gets plenty of good exercise, often has a good time hunting and fishing, and is constantly in touch with the unperishable library of the greatest author of all things.

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It is interesting to note the number of important new constructions required in the development of a large metallurgical operation. A case in point is that of the International Nickel Co. and its predecessors; in the treatment of the Sudbury copper-nickel ores, much "pioneer" work was involved and in consequence new treatment plants were planned almost as soon as works were completed and in successful running order; these constructions have culminated in the present splendid works of the Canadian Copper Co., at Coppercliff, Ont. The first blast furnace was installed under the direction of Dr. E. D. Peters, Jr., at the East Smelting Works in 1888; a second furnace was added in 1889, and in 1892 the first bessemerizing plant was completed. The East works suspended operations in 1901. In 1899 the West Smelting Works was erected near No. 2 mine. It was destroyed by fire on June 14, 1904. In July, 1900, the Ontario Smelting Works was erected by the Orford Copper Co., a company closely associated with the Canadian Copper Co. and one of the corporations included in the amalgamation in 1902, whereby the International Nickel Co. took over the interest of a number of corporations. This plant began operating in January, 1901, and was destroyed by fire on Feb. 19, 1904. Meanwhile it had been decided to erect another smelting plant about half a mile from the now old West Smelting Works and not far from the site of the original East works. Construction work was begun on the new plant in April, 1903, and it was placed in operation on July 17, 1904. The new plant contained two blast furnaces of about 400 tons capacity each; in 1905 it was enlarged by the addition of three more 400-ton furnaces. A new bessemer building was constructed in 1907 and operations started on May 14, 1908. In 1911, five basic converters of the Peirce-Smith type were substituted for 10 stands using 8x10-ft. acid-lined shells. The construction of two reverberatory furnaces, 19x112 ft., was undertaken in April, 1910, the first furnace being placed in operation on Dec. 23, 1911. In 1912 a new blast furnace was added; also four seven-hearth Wedge roasting furnaces, each 22 ft. 6 in. in diameter; however, the old practice of heap roasting is still employed.

Prospecting for Tin*

A recent discovery of stream tin at Battle Mountain, Nev., has led to inquiries at the Mackay School of Mines as to the method of prospecting for tin and of testing for it in the field. Director Lincoln spent last year in Bolivia, which is the only important tin producing country in the Western Hemisphere, and makes some suggestions covering these points.

Cassiterite is practically the only tin ore. It is an oxide of tin that when pure contains 79% of tin. Cassiterite occurs both in placer deposits and in lodes, but up to the present time the greatest production has come from tin placers, Bolivia being the only country whose principal production is from lodes. The rounded particles of cassiterite occuring in placers are called stream tin.

Cassiterite is a hard, heavy nonmetallic mineral ranging in color from light brown to black. It is most readily confused with the oxides of iron—hematite and limonite—but it is much heavier than these having a specific gravity of 7 whereas limonite has one of 4 and hematite one of 5. Moreover, both the iron oxides are soluble in acid whereas cassiterite is not attacked even by *aqua regia*.

If the tin prospector carries into the field some muriatic acid, granulated zinc and a test tube, he can readily test for cassiterite after the following manner: Place a piece of granulated zinc in the bottom of a test tube, put a fragment of the mineral to be tested on top of this, and cover both zinc and mineral with muriatic acid. The zinc will then dissolve with violent evolution of hydrogen and this nascent hydrogen will come in contact with the mineral. If the mineral is cassiterite, tin will be reduced on its surface, forming a silvery metallic coating. This adheres so strongly that if the specimen is rubbed it will polish the coating without detaching it. If, on the other hand, the fragment is not cassiterite, no such coating will be formed.

Placer-tin deposits are in almost every way similar to placer gold deposits. The stream tin being heavier than the rest of the gravel, it works its way to bed rock where it occurs concentrated. Small quantities of fine tin may occur distributed throughout the upper part of the gravel, especially if the valley is large and the stream small. As the prospector works up stream toward the source of the tin, the particles of stream tin will become more angular and larger—just as the gold colors become rougher and larger as the prospector approaches a gold lode. Thus it is that prospecting for tin placers and tin lodes is in every respect similar to prospecting for gold placers and gold lodes, the only difference being that it is somewhat more difficult to determine tin on sight.

*A bulletin of the Mackay School of Mines, Reno, Nev.

Japanese Mining Exhibit, Panama-Pacific Exposition

In the Japanese exhibit, now being installed in the Palace of Mines and Metallurgy, all branches of mining will be represented by raw specimens as well as the finished product. This exhibit, which is one of the largest individual showings in the building, covers about 7500 sq.ft. of floor space.

Built entirely by native workmen, the booths and kiosks are Oriental in style and the same scheme is carried out in the furnishings. One of the most interesting features of the exhibit is a large relief map of the Japanese mining region, done in colored clay. Among the more important exhibitors are the Kaijima, the Japan Sulphur and the Sumitomo Besshi copper mines.

January Mining Dividends

Mining dividends paid in January, 1915, by 17 United States mines amounted to $2,516,551, as against $7,258,432 paid by 34 mines last year. Industrials allied to mining paid $2,404,070 in 1915 as against $4,085,688 in January, 1914, and of the former $117,250 was in scrip, while Canadian, Mexican and Central American mines this year paid $1,114,508 as against $2,505,321 in 1914.

United States Mining Companies	Situation	Per Share	Total
Anaconda, c	U.S.	$0.25	$1,165,625
Bunker Hill & Sull., l.s.	Ida.	0.25	81,750
Bunker Hill Con., g.	Calif.	0.01	5,000
Caledonia, l.s.	Ida.	0.02	52,100
Camp Bird, pfd., g.	Colo.	0.085	110,565
Continental, z.	Mo.	0.50	11,000
Center Creek, z.	Mo.	0.05	11,000
Golden Cycle, g.	Colo.	0.10	150,000
Hecla, l.s.	Ida.	0.01	10,000
Homestake, g.	S.D.	0.65	163,254
Portland, g.	Colo.	0.02	60,000
Tennessee, c.	Tenn.	0.75	150,000
Tonopah, g.s.	Nev.	0.25	250,000
Tonopah Belmont, g. s.	Nev.	0.12½	187,500
Tonopah Extension, g.s.	Nev.	0.07½	70,757
Vindicator, g.	Colo.	0.03	45,000
Yellow Aster, g.	Calif.	0.02	2,000
Canadian, Mexican and Central American Companies	**Situation**	**Per Share**	**Total**
Butters-Salvador, g.	C.A.	0.36	$96,750
Consol. M. & S.	B.C.	2.00	116,088
Crown Reserve, s.	Ont.	0.02	35,376
Hollinger, g.	Ont.	0.20	120,000
La Rose, s.	Ont.	0.25	187,329
Lucky Tiger, g.s.	Mex.	0.10	71,534
McKinley-Darragh-Savage, s.	Ont.	0.03	67,431
New York & Honduras Rosario, g.	C.A.	0.30	60,000
Nipissing, s.	Ont.	0.25	300,000
Porcupine Crown, s.	Ont.	0.03	60,000
Iron, Industrial and Holding Companies	**Situation**	**Per Share**	**Total**
Am. Sm. Sec. pfd. A.	U.S., Mex.	1.50	375,000
Am. Sm. Sec. pfd. B.	U.S., Mex.	1.25	255,000
Bethlehem Steel, pfd.	Penn.	1.25	186,375
Brier Hill Steel, pfd.	Penn.	1.75	83,452
Guggenheim Expl.	U.S., Mex.	0.87½	727,768
International Nickel, pfd.	N. J., Can.	1.50	133,689
Penn Salt	Penn.	1.00	100,000
Sloss-Sheffield, i.	Tenn.	1.75*	117,250*
U.S. Sm. Ref. & Min. pfd.	U.S., Mex.	0.87½	425,536

*Scrip.

Yellow Aster is the only property in the January list which has not been a regular recent payer.

Tungsten Wire Filaments

O. Ruff in *Zeit. Ver. deutsch Ing.*, 1913, L., p. 1615 (through *Journ. Soc. Chem. Ind.*), says that to prepare a dense, ductile wire suitable for electric lamps, pure tungsten is first obtained by reducing the trioxide in hydrogen, and it is then compressed into rods which are hardened by heating gradually in a current of hydrogen in a tube furnace to 1000° C. for one hour. The rods are sintered by heating electrically up to 2850° C., the heating being carried out very carefully and slowly, as the quality of the final product largely depends on this process. The rods are then hammered and rolled at 1200°—1300° C. in a current of hydrogen in a special machine, the operation being repeated until the rods are reduced to the desired diameter. To point the rods before inserting them in the wire-drawing machine the ends of the thicker rods are dipped into molten potassium nitrite, and the thinner ones are made the anode in an electrolytic cell containing potassium cyanide. The finished tungsten wire is silvery white, malleable, tough, ductile and nonmagnetic. It is stable in air at ordinary temperatures but oxidizes at a red heat so that electric lamps with tungsten filaments have to be exhausted.

PERSONALS

S. F. Shaw is at San Antonio, Tex.

R. B. Lamb is at Grass Valley, Calif., examining some gold properties.

D. H. Ladd, of Houghton, Mich., is in New York on his return from London.

W. Spencer Hutchinson has removed to 1021 State Mutual Building, 50 Congress St., Boston.

C. H. Palmer, Jr., is inspecting the property of the United Eastern Mining Co. at Oatman, Ariz.

George H. Garrey is in Nevada, where he has been on professional work for the past two months.

L. F. S. Holland has returned to Los Angeles, Calif., from Searchlight, Nevada, where he has been making an examination.

G. F. Ehrenzeller, Pennsylvania Building, Philadelphia, now is representing the Carlton Iron Co. of England, manufacturer of ferro-manganese and spiegeleisen.

Baylies C. Clark has recently returned to California from Antioquia, Colombia, where for the past year he has been for Breitung & Co. examining placer properties.

H. S. Stebbins, who has been connected with the iron ore firm of Oglebay, Norton & Co., Cleveland, since 1892. has resigned. Mr. Stebbins is now enjoying a vacation in the East.

Thomas H. Bennett, superintendent of the Algomah, North Lake, South Lake and Indiana mining companies, in the Lake Superior Copper Country, spent several days in Chicago recently on business.

Edgar L. Newhouse has been chosen first vice-president of the American Smelting & Refining Co. in place of the late Barton Sewell. Edward Brush and S. W. Eccles are also vice-presidents of the company.

M. B. Tomblin, of Boulder, secretary of the Boulder County Metal Miners' Assciation, has been appointed deputy mine commissioner of Colorado and will live in Denver. He will also soon undertake the duties of secretary for the Colorado Metal Miners' Association.

J. Frater Taylor has resigned as president of the Lake Superior Corporation, Sault Ste. Marie, Ont., in order to devote his energies to the Algoma Steel Corporation, Ltd., of which he is president and general manager. Thomas Gibson, of Toronto, was appointed to fill the vacancy caused by the resignation of Mr. Taylor.

The Salt Lake Stock & Mining Exchange has elected the following board of governors for the coming year: R. J. Evans, president; W. D. Nebeker, A. L. Jacobs, J. T. Hodson, E. A. Hartenstein, F. C. Dern, W. H. Child, B. W. Dickson, and H. B. Cole. G. P. Norton is treasurer, and James Shorten, secretary. This exchange kept open notwithstanding the closing of exchanges throughout the country.

OBITUARY

August Heinbach, former superintendent of the old Franklin mill at Ripley, near Houghton, Mich., died at Butte, Mont., last week. He went from Prussia to the Michigan copper district in 1861 and was machinist at the Franklin mill. He installed the first engine in the South Pewabic mill. While working in the Franklin mill Heinbach, with John Funkey, now a leading hardware merchant of Hancock, invented the Frue vanner, a concentrating device that later became generally used. The idea originated with William Frue, then superintendent of the mine and Funkey and Heinbach worked it out and made it a practical success. It was the progenitor of the Wilfley table.

Colonel Timothy Kyle died at his home at Oakland, Calif., Jan. 13, aged 80 years. Born and brought up at Malden, Mass., he joined in the rush to California about 1850, when still a boy. After some years passed in that state he went to Colorado, and was among the pioneers there. After a time he settled in Leadville and for 30 years after that period he was a figure of prominence in Leadville mining circles, developing many mining properties which brought wealth to him and to others afterward. The Boulder, White Cloud, Bessie and other mining claims there are still held in his name. Some years ago he retired from active business and went to California to live.

SOCIETIES

University of Nevada—The Board of Regents announces the election of Archer Wilmot Hendrick, president of the University.

Idaho Mining Association—At the annual meeting in Boise James F. McCarthy, of Wallace, president of the Hecla Mining Co., was elected president.

Colorado Metal Mining Association—This association at its recent convention, elected the following officers for 1915: President, Bulkeley Wells, Telluride; first vice-president, George O. Argall, Leadville; second vice-president, Horace F. Lunt, Colorado Springs; third vice-president, Richard Roelofs, of Cripple Creek; treasurer, A. M. Collins, Creede; secretary, John M. O'Connell, Denver. Mr. O'Connell desires to withdraw in order to devote his time to newspaper work, and will probably be succeeded by M. B. Tomblin.

Wisconsin State Mining Trade School—A students' engineering society has been formed at the Wisconsin State Mining Trade School at Platteville. It is the purpose of the organization to hold meetings once in two weeks, at which some paper on a mining subject will be read and discussed. An interesting feature is the discussion, which is planned, of current articles in the engineering papers. At the first meeting, held Jan. 11, two papers were read by students, one on the "Kennedy Mine at Hazel Green," by Leslie Burns, and the other on "Mining Methods on the Menominee Iron Range," by David Skillings. Both papers were the results of personal experiences.

Canadian National Clay Products Association—The annual convention of this association was held Jan. 26-28 at the King Edward Hotel, Toronto, about 200 delegates being in attendance. Charles A. Miller of Toronto, president, in his opening address dealt with the present industrial situation. Mayor Church of Toronto extended an official welcome to the delegates. Officers were elected as follows: President, J. Edward Frid, Hamilton; vice-presidents, A. F. Greaves-Walker, Toronto; Thomas Kennedy, Swansea, Ont.; Wm. Burgess, Toronto; secretary-treasurer, Gordon Keith, Toronto; councillors, C. B. Lewis, D. A. Lochrie, W. McCredie, Angus German and John S. McCannell. It was announced that the association would give a complete ceramic laboratory to the new Toronto Technical School, which with its full equipment will cost about $6000. A number of technical papers were read and discussed. The proceedings were brought to a close by a banquet.

INDUSTRIAL NEWS

Chalmers & Williams, Chicago Heights, Ill., announces that it has the exclusive right of manufacture in the United States of the Nissen stamp mill.

The Hardinge Conical Mill Co. is in receipt of an order for three of its largest size ball mills, which are to be installed in the plant of Moose Mountain, Ltd., at Sellwood, Ontario.

The Terry Steam Turbine Co. has appointed Earl F. Scott, with offices at 702 Candler Bldg., Atlanta, Ga., representative for Georgia. Its Pittsburgh office—in charge of Mr. H. A. Rapelye—is now 1624 Oliver Building.

Wm. H. Kritzer, formerly connected with the Mine & Smelter Supply Co., also the Traylor Engineering & Manufacturing Co., has returned to San Francisco after supervising some changes in a mill at El Dorado, California.

A manufacturer near New York desires a supply of amorphous silica (either the gelatinous form or dehydrated) such as is produced in analytical operations. Will anyone in nearby territory producing this as a byproduct please advise the editor as to quantity and price.

David A. Wright, who for several years has been connected with the Yale & Towne Mfg. Co. as district manager in the West, has opened an office as manufacturers' agent, at 140 South Dearborn St., Chicago, Ill. He is specializing on pneumatic machinery, cranes, hoists and trolley systems.

A sand is wanted to take the place of French sand for fine statuary casting in bronze. This sand contains 80% silica and 20% alumina, that is, it is supposed to be a prepared mixture of sand and clay. The August Griffoul Bros. Co., 280 Chestnut St., Newark, N. J., will be glad to test and report free of charge on samples of sand sent to that address. Samples should not be less than 1 cu.ft. in bulk.

Editorial Correspondence

SAN FRANCISCO—Jan. 27

At the Exposition in San Francisco, California mining and metallurgical exhibits arranged by the several counties will be displayed in the California building. The State Mining Bureau exhibit will occupy space in the Mines and Metallurgy building. Seventeen of the northern and Mother Lode counties will form a composite exhibit. Siskiyou in the north and Calaveras and Tuolumne in the Mother Lode region will have seperate exhibits. Some of the southern counties also will have separate spaces. But the whole will be so arranged and placed as to make a harmonious display of the resources of the state. The 17 northern counties, including Amador, Butte, Colusa, Eldorado, Glenn, Nevada, Placer, Plumas, Sacramento, Shasta, Sierra, Solano, Sutter, Tehama, Trinity, Yolo and Yuba formed an organization provided for by the legislature, composed of one commissioner from each county. Charles H. Dunton, mining engineer, of Sacramento, and M. E. Dittmar, of Redding, were placed in charge of collecting and assembling the various county exhibits of this organization. About 5000 sq.ft. of floor space are reserved for this mining exhibit, with a 90-ft. frontage and a depth of 50 ft. The main entrance columns are 5 ft. in diameter, the bases 5 ft. square, of metal construction. The columns are of blister copper, the surface having a high luster. Copper mines are represented by a column 12 ft. high, 4x4 ft. in section, showing characteristic ores set off in blocks. The same plan is observed in representing gold-silver and lead-zinc ores, and also cinnabar, iron, coal, manganese, magnesite, pyrites, asbestos, etc. The granite display contains one mass 27 ft. long, 10x12 ft. in section. Clay and clay products are strong features. The centerpiece of the mineral exhibit is a round plate-glass case on a mahogany base, 8 ft. in diameter, divided into segments, one for each gold-producing county. This contains specimens of native gold aggregating more than $100,000 in value and including nuggets worth as high as $1200. Every form of native gold known in these counties is shown. One of the great features of the exhibit is an exact working model of La Grange hydraulic mine in Trinity County, showing giants in active operation. A model dredge built by Yuba Construction Co., on a small scale, but equal to practical demonstration of the methods of recovering gold by the California type of bucket-elevator dredge, will operate within the exposition grounds and produce the gold as in the operation of La Grange mine. The model milling plant consisting of two batteries of five 20-lb. stamps, rock breaker and concentrating tables, etc., will crush gold-bearing ores and recover the gold. Besides the ores and the methods of treatment exhibited, the mineral-producing counties will be represented by specimen cases, which are always of interest to the general visitor.

Moving Pictures are to be a feature of the mining exhibits in the California building, and also in the Mines and Metallurgy building. The pictures prepared for the California building are now being exhibited at San Diego, where the Panama-California Exposition opened on Jan. 1. The principal photographs in this exhibition are a complete illustration of actual mining and milling of ore at the Kennedy mine in Amador County, the largest gold mine in the Mother Lode region and the deepest mine in the state. The initial picture is taken from the 3600-ft. level, showing three drills operating in an 11-ft. face of ore. Breaking down of the ore, tramming to the bins on this level at the shaft, hoisting to the surface, dumping into the orebins at the mill are followed by the picture machine. Then the actual operation of the stamp mill, amalgamation, concentration and the cleanup are shown, then the retort room and the ultimate production of a gold brick. The compressor room, hoisting machinery and all other operating parts of the mine are reproduced. The pictures to be exhibited in the Mines and Metallurgy building at San Francisco include underground and surface mining, both deep mining and hydraulic operation. It is understood that the Goldfield Consolidated will contribute to this exhibition and that coal and iron mining will also be included.

At the San Diego Exposition, 10 of the northern and Mother Lode counties are represented. These are Eldorado, Placer, Plumas, Sacramento, Shasta, Solano, Tehama, Yuba, Colusa and Glenn. The two last named are not strictly mining counties, though Colusa is the largest producer of sandstone in the state. Southern counties exhibiting at San Diego include Kern, San Bernardino, Inyo and the oil-producing counties, embracing the large fields. Altogether the Panama-California Exposition at San Diego is making a fine showing of the mining industry of the state.

DENVER—Jan. 28

An Appropriation of $20,000 for the further equipment and operation of the experimental ore dressing and metallurgical plant at the Colorado School of Mines at Golden has been introduced in the legislature. The appropriation will be used for equipment, maintenance, heating plant, and salaries for experts attached to the plant. An emergency clause makes the bill take effect from and after passage.

If Spectacular Ore Finds afford an index to the earnestness with which Colorado's miners are exploring, one might predict that 1915 will prove an unusual year in mining activity. Nor are the numerous strikes fictitious, although, of course, material discount must be applied to all newspaper accounts of such discoveries, in order to reduce them to facts. These rich finds have occurred in various camps. Naturally there has arisen a rivalry among the country journalists to outdo one another in "stories"; but when one sifts down all these accounts and rumors he finds that there exists a determined revival in mining and prospecting and that the old districts—not new ones—are furnishing genuine surprises. The Cresson at Elkton, the Dunkin at Breckenridge, the Two Forty at Central City, the Gordon at Twin Lakes—these are instances of bonanzas recently opened and are cited to show that they are wide spread in their occurrence. This latter fact encourages prospectors all over the state although, until summer, it is unlikely that they can accomplish much except in mines that are already more or less developed.

BUTTE—Jan. 28

Labor Unions—Six weeks ago a mediation board was created for the purpose of reorganizing the miners of the Butte camp. To this board, which is indorsed by the Silver Bow Trades & Labor Assembly, the differences between the miners' unions of Butte were referred. At a recent meeting it came to the conclusion that the only avenue left for the reorganization of the miners is through the Western Federation. This suggestion was condemned by all speakers at a meeting of the Butte Mine Workers' Union held Jan. 25, but no action was taken upon it. Hearing of the case of the Western Federation against Butte Miners' Union No. 1 took place in Judge McClernan's court Jan. 25. The Federation seeks to compel those in charge of the local union to turn over to the parent body all moneys and property it may have. This consists of a big sum of money, besides ownership of what is left of the old hall and a big mortgage on the hall in Lead, S. D. Arguments have been along the lines as to whether an incorporated and voluntary organization can sue in the name of its officers and without the rest of the membership being parties thereto. The biennial convention of the Montana Federation of Labor will be held in Helena, beginning Feb. 1. It is stated that the convention will take steps to initiate a law governing and limiting the issuance of injunctions as between employer and employed. The compensation measure will also come before this body, and possibly the convention may take a stand on the proposed prohibition measure which will be submitted to the state legislature or initiated. At a meeting of the Silver Bow Trades & Labor Council, held Jan. 25, this body went on record as opposed to prohibition in Montana.

SALT LAKE CITY—Jan. 28

At the Arthur Mill of Utah Copper, several sections were started again Jan. 25. These have been put in operation in order to limber up the machinery and to take care of material formerly treated in a part of the Magna mill, which is undergoing some alteration. Also, as is usual at this time of the year, some trouble has been experienced from frozen ores. No increase in copper production above the 50% basis will be made. A few more men will be given employment on account of the changes. The December output was 6,795,567 lb.

SEATTLE—Jan. 27

At Nome in Alaska a new gold strike showing 4 ft. of pay dirt, according to information, has aroused the interest of operators. Edward ("Nugget") Johnson, a well known old timer in the district, has struck gold on a claim near Montroville, halfway between Nome and Little Creek. The strike was made about Jan. 1 but the news has only just leaked out. Johnson drifted under a frozen lake and found a body of gravel 4 ft. deep carrying an average of 40c. to the pan. Drifting has been done for a considerable distance, the pay continuing to hold as far as the ground had been worked and it is estimated that Johnson now has about $100,000 worth of ground blocked out. Many of the well posted miners in the district maintain that this strike is a continuation of the Walrus, on Little Creek, which produced heavily a few years ago. Numerous outfits are now prospecting in the vicinity and mining activities have received a new impetus.

In the Chisana camp of Alaska miners are reported busy. A gang of men is blowing out the falls on Bonanza Creek, and another is at work on the cañon on Johnson. There is a crew on the McCarthy trail via Scolai Pass getting it in shape, as many operators are expected the last part of the winter and many supplies are coming in. G. R. Goshaw is doing work on Little Eldorado on the right limit benches and has a good chance of hitting the old channel. He also has a large interest in six claims on Ptarmigan Creek, a tributary of Beaver, where considerable prospecting is being carried on and where colors are showing. Rim prospects look fairly well. Pumps are being brought in for the wet ground on Alder Creek where considerable work is being carried on and the indications are that it will be the best creek in the district next summer.

Quartz Men are optimistic in the Fairbanks district of Alaska and properties will be developed with rapidity during the present winter according to report. A custom mill has been built by Charles Heilig. The plant consists of a Huntington mill and was formerly located on the Tolovana quartz property; it has a capacity of about 10 tons of ore a day. It will be ready for work during the early part of February and the prospectors of the district will have about 100 tons of ore ready to mill by that time. Crites & Feldman who have recently installed a new plant are reported to be doing well and are well pleased with the showing made. They have enough ore blocked out to keep them busy for many months. There will be much more development on the quartz properties in the vicinity of Fairbanks Creek after Heilig's mill is working than before, as the cost of freighting and milling will be reduced from about $14 a ton to less than $6.

Among the Placer Mines, those on Happy Creek report promising conditions. John Fahy who first struck pay a few weeks ago, is in dirt now that looks even better than when he reached bedrock. He has drifted about 50 ft. from the shaft and the dirt pans an average of 8c. Strauss, Cosgrove & Letendre are working about 700 ft. above Fahy and have struck equally good dirt. A new outfit is expected to start work within a few days and the men think that before winter is over there will be others taking lays on the ground. Good pay on Pedro Creek has been located by laymen on No. 2 Below bench claim. They sunk a shaft to bedrock several weeks ago but found practically nothing. Starting to drift recently they discovered pay running on an average of about 7 to 8c. per pan. Although the creek requires open-cut methods, and is worked most extensively in summer, there are a number of small outfits now on the ground and doing well.

SPOKANE—Jan. 27

A Complete Directory of Inland Empire mining properties is being compiled by the Mining Men's Club of Spokane in connection with the Northwest Mining Convention to be held in Spokane Feb. 22 to 27. H. H. Shallenberger, chairman of the committee in charge of the ore show to be held in connection with the convention, is endeavoring to get in touch with the owners of every mine in the Inland Empire in an effort to get samples of ore for this display and for subsequent permanent exhibition in Spokane. Each exhibit is to be accompanied by complete information as to output, value, character of formations and development, in addition to available maps, plans and photographs. Mr. Shallenberger has opened headquarters in the Hotel Spokane, where ore shipments will be received. Emissaries to herald the convention and ore show in the mining districts started a series of visits to the different camps this week. Mr. Shallenberger went to Nelson, Rossland and Trail; N. C. Titus and E. L. Bruce are visiting the Cœur d'Alenes. E. P. Wheeler, of Conconully is covering the Okanogan country, and F. R. Wolfle, who is in the Ainsworth district, is representing the convention. J. W. Douglass is covering the Similkameen district.

Active Placer Mining operations are contemplated by several companies, in the Pierce region, in Clearwater County, Idaho, according to information received recently. John M. Porter is planning to work 100 acres of placer ground formerly owned by the American Placer Mining Co., on Orofino Creek, seven miles from Pierce. It is estimated that it will return about 25c. per yard. The Pierce placers yielded hundreds of thousands of dollars in the early '60s, and while the ground has been worked over several times since, dredging operations still are profitable. A dredge that was removed from Delta to Pierce by a company organized by M. H. Hare, who disappeared several months ago from Spokane, has been acquired by Mr. Porter. A 2000-ton daily capacity dredge has been constructed by the Hare company and is operating. W. J. Harris has a large tract of placer ground on Quartz Creek, about four miles from Pierce. A sawmill has been constructed and a contract let for 100,000 ft. of lumber for a dredge, to be operating some time this summer. With the installation of the Harris dredge there will be three boats operating near Pierce.

LAKE CITY, COLO.—Jan. 27

The Lake City district has witnessed lately several strikes of importance. That made by Carey & Ochsenbein on the Last Chance group late in December is proving up well. At a depth of 50 ft. in the shaft the ore is over 2 ft. wide and is increasing. A recent sample showed $3 in gold, 180 oz. of silver and 60% of lead. Buskirk & Witherite are opening up an excellent streak in the shaft. They expect to sink another 50 ft. and drift; in the meantime they are sacking some fine lead-zinc ore showing wire silver. Shipments are running well. Ralph & Watson have just shipped a 20-ton car of gray-copper ore; two cars recently shipped ran $108 and $120 to the ton. They are working a lease on the Fanny Fern. Monroe & Quayle have taken a lease on the Cora and the Sulphuretts and will soon make a shipment running $60 per ton. Jeff and James Pool will ship soon a car of $100 gray-copper ore from the Belle of the East. Will and John Rawson have moved down from Schafer Basin and have packed provisions up to the crosscut tunnel which they expect to continue as long as weather permits. Their work is on the Crown Point property operated by William Taylor, of Kansas City.

JOPLIN—Jan. 30

Activity Among the Mines has been still further increased by the continued high price of zinc ores. Sheet-ground mines are being opened up and got into the producing column as fast as is possible, although activity along this line is somewhat restricted because of adverse weather conditions. A large number of the operating plants have been forced to shut down because of freezing. With the advent of warmer weather the district will become much more active. There are now a number of projects on foot to pump out large tracts of old ground formerly mined at shallow levels. At most of these places prospect drilling has proved the existence of orebodies at lower levels, such as the Maggie Taylor tract at Galena and the Missouri Zinc Fields' and Carterville Land Co's. tracts at Webb City, where the operators are even now mining rich ore under the old workings. A number of others are sinking their shafts preparatory to taking up stope in the old drifts or going down to entirely new levels. The Oronogo Mutual Mining Co. at Oronogo is sinking a new shaft on the west side of its lease in order to mine a rich run of ore that the Oronogo Circle Mining Co. is said to have mined up to the line. The sinking of this shaft will take place practically within the city of Oronogo, and it will require great care on the part of the shaft sinkers to avoid damage to property. The Oronogo Circle recently completed an entirely new haulage system for the transfer of the ore from the various shafts to the mill. This system is a regularly constructed railway using gasoline locomotives of the Milwaukee type, weighing 5½ tons, and ordinary three-ton end-dump cars. The company is getting more than enough ore to supply the mill and this at a much reduced cost per ton. The transportation cost under the old system was about 3c. per ton, while under the new system it is about 1c. The plant is milling about 900 tons daily. This property was recently sold to Turner & Co. of New York. Since the new management has taken charge a number of changes have been made with a consequent saving in the cost of operation.

DULUTH—Jan. 30

Steel Corporation Pensions have been paid to iron-country employees to the extent of $21,331. This includes the two Minnesota ore roads. The pension system began to operate in 1911. Pensions are computed as follows: For each year of service the employee receives 1% of his average monthly pay during the last 10 years of service. All male employees who have been in the service 20 years or longer and are 60 years or more of age are eligible to a pension. Women are eligible at

the age of 50 years. More than 70% of those now on the pension rolls voluntarily requested to be pensioned. Early in 1913 the permanent disability rule was amended so that any employee, age not considered, who has been in the service 15 years and who has become absolutely unable to earn a livelihood, through no fault of his or hers, as a result of sickness or injuries sustained while on duty, is taken care of by the voluntary accident relief plan. The distribution of the fund received by the various properties operated by the Oliver Iron Mining Co. and by the Duluth, Missabe & Northern and the Duluth & Iron Range is as follows: Mesabi Range; Adams, $288; Canisteo, $223; Glen, $52; Graham, $24; Spruce, $898. Vermilion range; Pioneer, $334; Soudan, $734; Zenith, $98. Menominee range; Aragon, $659; Chapin, $1744. Marquette range; Champion, $1685; Lake Superior, $6720; Queen, $1306. Gogebic range; Atlantic, $288; Norrie-Aurora, $3362; Tilden, $1726. Duluth & Iron Range R.R., $599. Duluth, Missabe & Northern, $591.

CHICAGO—Jan. 30

Experiments with Drills continue in the Lake Superior copper district, notwithstanding the fact that the Calumet & Hecla, after extensive trials and experiments, threw out the old two-man type several years ago and substituted a lighter machine, the whole transaction undoubtedly representing a considerable expenditure. Numerous tests are being made at the present time there and others are contemplated. Moreover, there are those who believe that the innovation of three years ago may be superseded in the not distant future by a still more efficient machine. It is certain, too, that competition among the drill manufacturers is keen, and it would be surprising if the ultimate result of these efforts was not an improved drill exceeding in efficiency anything yet adopted in that district. While it is too much to expect that a company using several hundred machines would discard them for a new one that differed only in some small particular, it is equally certain that any radical improvement which can show a material increase in efficiency, reduction in cost of production, lower cost of maintenance, etc., will be given serious consideration. And no better time than the present could be found for testing machines of any sort in that district.

This January has been its best month in two years, according to a concern making a variety of mining and milling machinery. A manufacturer of an important adjunct of hoists, grinding mills and other machines used in mining is taking on skilled men to such an extent that it has created comment among the men themselves. These indications that the mining business is improving are supported, too, by recent developments in the Lake Superior ranges. In the Copper Country the welcome announcement was made recently that the Copper Range group, the Trimountain, Champion and Baltic, commencing Jan. 19 would continue operations on full time. Since early last fall this company has been operating at a greatly reduced capacity, 15 days on and 15 off. In the Michigan iron country also the scale of operations is being increased.

Sand-Leaching experiments, it can be stated positively, are being carried on in the Copper Country with other processes than that to be employed by the Calumet & Hecla. And they have been sufficiently successful, in at least one instance, to warrant increasing the scale of experimentation. It is also certain that men who have no direct interest in the mines of that district are watching these experiments with great interest. If entirely successful on the larger scale, it will probably mean that the Lake Superior country will witness the development of a new industry, the leaching of once discarded stamp sands. There are great quantities of these sands available from the mills of the Wolverine, Mohawk, Franklin, Quincy, Copper Range and possibly some other mines. In some of these cases, the work would undoubtedly be performed by the mining company itself, but it is not unlikely that in other cases separate companies might be formed for the purpose, or outside individuals might obtain the sands under satisfactory arrangements, and conduct the work as separate enterprises. To be successful the operations must be conducted on a large scale, which is, of course, in keeping with the traditions of the district. Much machinery of various sorts would be necessary. The leaching of these sands is a live subject, and its success on a commercial scale, whatever the process be, means much for the district.

HOUGHTON—Jan. 30

The Calumet & Hecla for 44 years has been producing almost continuously from the conglomerate formation upon which it was originally opened, and today the old conglomerate lode still continues to furnish the bulk of the tonnage which goes to the stamp mill. Thirteen fully equipped shafts, each one practically a mine by itself, produce a monthly tonnage of 350,000 and account for more than four-fifths of Calumet & Hecla's copper.

About 80% of normal output is coming at the present time from the conglomerate mines of the Calumet & Hecla and they are working just three-quarters of the time. At the Hecla four shafts are in operation, Nos. 2, 3, 6 and 7. These are all doing as good work as at any time in their recent history. In fact, for the past five months the grade of rock in the lower openings of both the Calumet and the Hecla branches has shown a slight appreciation. None of these Hecla shafts is taking down pillars. At the South Hecla, the branch which is more nearly worked out than any other part of the C. & H. property, there are four shafts in operation, Nos. 8, 9, 10 and 11. In No. 11 the work practically is confined to the removal of pillars and this rock is, of course, the richest that is going to the mills from any part of the mine, running over 40 lb. to the ton and getting richer as the work comes closer to the surface. Shafts 9 and 10 constitute a double shaft; this has a good deal of workable ground yet to go before reaching the limits. It is in healthy general physical condition. At the Calumet branch four shafts are in use, Nos. 2, 4, 5 and 6, 5 and 6 being a double shaft. The conglomerate lode is averaging at the present time 30 lb. of copper, refined, to the ton. This is about the general run of the lode for the past few years. The average for the year 1914 was, however, nearer 26 lb. to the ton, the first seven months of the year showing a poorer grade. In addition to the three main mines, South Hecla, Hecla and Calumet, another important producing shaft of the conglomerate formation is the Red Jacket which mines a territory north and west of the Calumet branch and beyond the Tamarack lines. Its hoisting speed and magnificent equipment enable this one shaft to handle a large tonnage. Working three-quarters time it produced 36,000 tons of rock in January. This is all high grade.

On the Osceola Formation the Calumet & Hecla mine is operating five producing shafts now. This lode is showing no change in general character. The mine is young as yet and its production possibilities are very great. While the grade of rock is low, the grade of copper produced is the best in the world, ranking with the Quincy and Mass in the government metal tests. This Osceola lode is wide and variable in quality. It can be mined to show a product of 9 lb. to the ton, or 30, depending upon the selection after breaking down. At the present time the grade is running 14 lb. to the ton. This is profitable mining at the present price of copper and with Calumet & Hecla economy.

On the Kearsarge Lode on the Calumet & Hecla property proper no operations are being conducted. Contrary to general understanding but one shaft has been opened on this lode by this company. The exploration work has not been extensive enough to prove conclusively, one way or the other, just what the values may be on the extensive spread of this formation through the Calumet & Hecla territory.

Minority Interests in various properties in the Lake Superior district were bought in 1905 by the Calumet & Hecla, $9,000,000 being expended. Notes were given for these stocks. They have been paid off in full. Of these assets the Ahmeek is undoubtedly the richest and most profitable at present. Calumet & Hecla owns nearly one half of the stock in Ahmeek. This is a young mine, richest on the Kearsarge lode, has four workable shafts, two now in operation, and but 60,000 shares outstanding. It will, in a few years, become one of the largest producers of the Lake Superior district, as well as the richest, excepting the conglomerate lode. Next to the Ahmeek, the ownership in the Osceola Consolidated is the most valuable asset held in any producing corporation. Both of these companies are in excellent physical condition and are heavy contributors to the Calumet & Hecla treasury in normal times. The stock ownership of 27,000 shares in the Isle Royale, instead of being a liability, as at first feared by the management, is now a profit producer. Of the various exploratory undertakings which the Calumet & Hecla interests financed in their efforts to acquire additional opportunities to utilize their marvelous organization and equipment, the White Pine property in Ontonagon County holds out the best hope for the future. While it is impossible to secure from any of the managerial heads any expression beyond the expectation that the White Pine will repay the money spent in its development and equipment, the fact remains that all of the experienced miners who are working in this property unhesitatingly state that it is richer than the Calumet conglomerate. Its narrow vein makes mining costs high. But the fact remains that the true worth of White Pine will be given a practical demonstration within a few months when the thousand-ton stamp mill commences work. There is no public ownership of this stock, so that there can be no market gage of its speculative value.

The Mining News

ALASKA

ALASKA GOLD (Juneau)—At stockholders' meeting Jan. 21, issue of debentures and increase of capital stock authorized.

ARIZONA

Cochise County

RAISE IN WAGES in Bisbee announced Jan. 27 for all three leading companies, following increase in copper prices. Copper Queen notice provides four scales based on "Engineering and Mining Journal" copper quotations. Sample as follows: Present rate $3.50; copper, 13c. to 14c., $3.65; 14c. to 15c., $3.75; over 15c., $3.90. Merchants, men and officials all much pleased.

Gila County

RAILROAD RATE REDUCTION reported as ordered by corporation commission on ores, concentrates, etc., from all points on Southern Pacific and Arizona Eastern to Globe and Miami.

CALIFORNIA

Eldorado County

GROUND SLUICING in Hangtown Creek which runs through town of Placerville recently started by E. L. Hews and G. A. Finnigan. Plant situated in rear of courthouse. Hangtown Creek in early days was mined by ground sluicing and hydraulicking and produced large amount of gold. Recent effort made to change name of Placerville to Hangtown, name first given to town.

Nevada County

THOMAS THOMPSON RANCH (Grass Valley)—This 80-acre ranch near North Star mine, containing well defined gold-bearing ledge striking north and south, bonded by W. A. Simpson. Number of previous efforts made to purchase property.

BEN FRANKLIN (Grass Valley)—Company organized by Toronto men to reopen mine a few miles south. Pump started to handle water which is 200 ft. deep in 400-ft. shaft. Mine said to have record of $750,000 production. Hoisting and building equipment said to be complete.

UNION HILL (Grass Valley)—Three-compartment shaft completed to 800-ft. point. South crosscut being driven to cut downward extension of oreshoot intersected in winze from 600-ft. level. Vein opened by drifts 100 ft. on 600-ft. level, showing width of 4 ft. Ore assays $15 per ton.

OUSTOMAH (Grass Valley)—Twenty men employed; 10-stamp mill crushing ore from 400-, 500-, 600- and 700-ft. levels. Lower levels being unwatered and 800-ft. level will soon be ready for extraction of ore. Shaft being repaired; new track being laid; 1500 ft. of cable added to underground equipment; four new drills installed; other improvements being made. Deepening shaft contemplated.

Shasta County

ROSS (Coram)—A. R. Ross making arrangements for installation of five-stamp mill in Stillwater district.

MAD OX MINING CO. (Stella)—Time extended for payment of purchase price of this group of mines near Old Whisky Town. Extensions to July 1915 and May 1916.

MAMMOTH (Kennett)—Arrangements made for regular shipments of high-grade zinc-silver ores to Oklahoma. Sorting plant about completed. Reported large tonnage of ore averages 26% to 40% zinc. Also zinc has been developed in Friday-Lowden property recently purchased by Mammoth.

Tuolumne County

SANTA YSABEL (Sonora)—Preparations being made for reopening property under management of J. A. Prentice of San Francisco. Mine former producer.

CONFIDENCE (Soulsbyville)—Company organized to reopen this old mine. Understood tunnel will be driven from Davis Flat section to tap vein at depth.

COLORADO

Boulder County

LIVINGSTON (Boulder)—Roasting plant of United States Gold Corporation's mill, comprising Herreshoff unit, under erection. No. 2 shaft unwatered and equipped with electric pump. Levels being opened to furnish ore for mill when latter is ready.

Clear Creek County

UNITED GOLD MINING, MILLING & TUNNEL CO. (Idaho Springs)—All property of company, situated in Spanish Bar district, to be sold at public auction in Idaho Springs, Feb. 1, in accordance with decree of foreclosure in which Central Savings Bank & Trust Co. of Denver, as trustee, is plaintiff. Property includes many lode claims and water rights.

Eagle County

LADY BELLE (Eagle)—This silver mine, that came into notice two years ago and after short, brilliant operation was thought exhausted, has resumed shipping under lease. First orebody proved to be dislodged block of sandstone highly impregnated with silver minerals. When this great rock was excavated, formation in place could not be found. Now, R. A. Messa, and others, have found true orebody and are shipping same sort of ore.

Gunnison County

CARTER MINING CO. (Ohio City)—At recent stockholders' meeting old board of directors was reëlected and acts of officials during 1914 approved. During 1914 company performed about 10,000 ft. of development work, including completion of four-compartment vertical raise which has total height of 1100 ft. Company plans considerable new development during present year. Several new leases will be granted during 1915. C. M. Carter president of company and A. H. Schreiber superintendent of property.

Lake County

PENROSE (Leadville)—Machinery arriving and being set for Down Town Mines Pumping Association which plans to unwater lower part of district.

GORDON-TIGER (Twin Lakes)—George W. Boyce, manager and principal stockholder in Twin Lakes M. & M. Co., reports discovery, above the fifth adit level, of 3-ft. shoot which his own samples show to run better than 1 oz. gold, while 8-in. streak in same vein runs much higher. Ore is white quartz with some pyrite and galena, gold occurring in free state. Interval of 280 ft. between fifth and fourth adit levels, assures abundance of stoping ground. For some time, Boyce has been making shipments to Arkansas Valley plant, of ore assaying about 1 oz. gold, a little silver and 10% lead.

BIG FOUR (Leadville)—Mining plant, including new shaft-house, engine-room, dwelling house, snow-sheds and some of the surface tramway, demolished by fire supposed to be incendiary, night of Jan. 20. Machinery thought to be badly injured if not total loss; total estimated loss set at $20,000. Fortunately, fire did not extend down new shaft. Last week Big Five company, which leases property, entered into contract with Colorado Power Co. and proposed to substitute electric motors for steam ends of machines. These had already been ordered and will be placed in rebuilt plant. Supt. Olie Strom has been in Denver consulting directors of Big Five, states they propose to build new mine plant promptly. All headway gained in unwatering together with pump and motor now total loss.

Summit County

FRENCH GULCH GOLD DREDGING CO.(Breckenridge)—Reiling boat went into winter idleness Jan. 5, close to Wellington mills. Until spring conditions warrant resumption of digging, time will be utilized in various repairs.

Teller County

GRANITE (Victor)—Gold Coin shaft being sunk.

PORTLAND (Victor)—Sinking No. 2 shaft discontinued; skip-pocket being put in on 17th level.

ACACIA (Cripple Creek)—South Burns shaft-house destroyed by fire, 6 p.m., Jan. 26. Shaft had just been sunk 100 ft.

STRATTON ESTATE (Cripple Creek)—Plant of machinery at Logan shaft leased to Kishman and Rainger. This plant supplies most of Bull Hill mines with compressed air.

EL PASO (Cripple Creek)—New electric hoist being installed and steel headframe nearing completion on old shaft. Work through shaft and on drainage tunnel suspended since fire last fall.

VINDICATOR (Independence)—No. 2 shaft-house destroyed by fire 4 a.m., Jan. 27. Shaft timbers not damaged. Shaft not used except by lessees. New electric compressor installed and put into commission.

CRESSON (Cripple Creek)—Shipment of high-grade ore sent to Copeland sampler Jan. 24, from now famous vug on 12th level. Two cars in one lot, 80 tons, of first grade and three cars, 88 tons, of second grade. Entire shipment sampled twice, and extra precautions taken for sampling. Sent for treatment to Denver plant of A. S. & R. company. Average grade about $3 per lb.; total about a million dollars.

IDAHO

SUCCESS (Wallace)—Work resumed in shaft, sinking to 1100 ft. level. Chief value of ore from this mine lies in zinc. Present high price stimulating development. Mine now making about 80 tons zinc concentrates daily.

H. E. M. (Wallace)—Stockholders have approved plans for erection of 100-ton concentrating mill at mine. Steps taken to raise $20,000. Work to start as soon as season permits. Tunnel No. 4 in 2276 ft. Vein drifted on 250 ft.; good body of ore uncovered and high grade will be shipped.

IDAHO-NEVADA (Wallace)—First shipment of copper ore made from Castle Rock mine. Sent to Tacoma; expected to run 27% copper with some gold and silver. Ore taken from dump and sorted. Shipment an experiment. Smelting cost low, as iron content is high. Work on shaft discontinued awaiting stockholders' meeting Feb. 6; bottom was still in good ore, although ore was dipping out of shaft. Oreshoot said to be proved over 200 ft.

MICHIGAN

Copper

BOHEMIA (Rockland)—Bohemia, selling in market at $1.06 a share has over $100,000 in cash in treasury.

MICHIGAN (Rockland)—Idea of ridiculously low figures at which idle copper properties are selling given by case of Michigan mine. Standing white-pine timber on property alone said to be worth practically twice the present market selling price.

ARCADIAN (Houghton)—Arcadian has about $10,000 in treasury. Monthly expenses now a little over $2000 so that company has enough money to keep up present operations until next summer. In addition there is $8000 due in uncollected payments on last assessment levied. This can be forced at any time with market in present position.

MINNESOTA

Cuyuna Range

MERRIMAC MINING CO. (Crosby)—Company states it will not drill lands south of Croft mine.

JOHN HARRINGTON granted lease on lands willed to City of Brainerd by late Judge George W. Holland, of Brainerd. Lands have some prospective mineral value. Term of lease 50 years, royalty 30c. per ton, with 10,000-ton minimum first year and 25,000 tons annually thereafter. Exploration work will start at once.

STRIPPING operations to be extensive in 1915. Following mines contemplate this work: Rowe, Hill Crest, Cuyuna-Sultana, Quinn, Feigh, Pennington, Armour No. 1. Last named will strip western end adjoining Pennington; owing to presence of caved ground from underground mining east end cannot be stripped.

Mesabi Range

GREAT NORTHERN POWER CO.—Arrangements being made to extend lines from Hibbing to Nashwauk and beyond, on Mesabi range, enabling furnishing of power to mines in district.

GREAT NORTHERN ORE CO.—Reported number of ore contracts already made for delivery this year. Trustees have several mines ready to produce ore on short notice and several more in development stage. Three properties leased to Dean Iron Co., but all other ore lands will be operated direct by trustees. On properties leased, trustees have made extensive advances in the past for development work, to be reimbursed gradually, payments being made on royalty basis on ore mined. On largest mine trustees will be paid royalty on every ton of iron ore taken out during life of lease, in addition to being reimbursed for advances made. On other two mines leased, payments will cease after advances have been repaid. Trustees have cash surplus of about $9,000,000. This sum will be available for nest egg for carrying through further development work on various mining locations where ore is known to exist. Over $3,000,000 advanced to Sargent Land Co., which is opening Keewatin mine, amount to be paid back in royalties.

Vermilion Range

SIBLEY (Ely)—Hoisting resumed in shaft which caved in Nov. 9.

MONTANA

Granite County

MONDAMIN (Philipsburg)—Rich strike reported from this mine made on vein believed to be continuation of vein in famous Granite mine which has yielded much silver in years past. Shaft on Mondamin mine down 80 ft. At this point vein 7 ft. wide. Holes sunk on surface exposing vein, showed it continuous and in direct line with Granite vein. Shaft will be sunk to 200 ft. before doing exploring or drifting.

Jefferson County

CORBIN COPPER (Corbin)—Leasers at Rosalie claim have opened promising vein in tunnel, showing more than 1 ft. of ore of concentrating grade and several inches of rock of higher class, which leasers are sorting for shipment direct to smelter. Bakama claim, in western end of group, expected soon to be operated by leasers. Showing in this claim regarded as favorable. Nothing being done by the Corbin Copper at Gambrinus group in Butte district pending clearing of financial difficulties of company.

Silver Bow County

ANACONDA (Butte)—Extensive improvements being made at Mountain View shaft. Shaft straightened and retimbered for great portion of its depth; headframe moved; building of new engine house started, of steel construction, to be one of the finest and most substantial in the district.

BUTTE-BALLAKLAVA (Butte)—Company has announced operations will be resumed by middle of February, when it is expected to hoist in neighborhood of 100 tons per day. This will mean employment of 50 to 100 men. Retimbering of shaft has been progressing steadily in meantime and as soon as conditions warrant, shaft will be sunk below 1600-ft. level, its present depth.

PILOT BUTTE (Butte)—Due to improvement in metal market company has announced following plans for increasing present output: Company will at once begin mining zinc ore at rate of 50 tons per day; shaft will be sunk from present lowest level of 2450 ft. 400 ft. deeper to 2850-ft. level; three distinct zinc veins carrying from 20% to 30% zinc will be opened up and exploited at fastest possible rate in addition to output of copper ore. Force of men will be increased at once from 60 to 100 and three shifts put on in place of two. During January, 21 cars of first-class and nine cars of second-class ore were shipped. Estimated that in February output will reach 60 cars.

NEVADA

Esmeralda County

GOLDFIELD SAMPLER of Western Ore Purchasing Co. made first run of ore Jan. 20. Plant completely remodeled and capacity increased from 150 tons to 350 tons daily.

DIAMONDFIELD MINING & MILLING CO. (Goldfield)—Company operating lease on Great Bend property. West drift on 150-ft. level opened 3-ft. shoot of milling-grade ore and 8-in. shoot of shipping-grade; shipments to begin at once.

GOLDFIELD CONSOLIDATED (Goldfield)—December production 29,851 tons, with net realization of $195,118. Development work 2628 ft. at $5.66 per ft. Principal costs: Mining, $2.72; milling, $1.91; general, $0.43. Total cost, $6.03, less miscellaneous earnings $0.36; net cost $5.67.

Humboldt County

ROCK HILL (Mill City)—Force of men began operations recently.

Lyon County

NEVADA PROGRESSIVE GOLD MINES CO. (Yerington)—New shaft-house built, gasoline hoist installed and new office building completed. Sinking started from 100-ft. level.

Nye County

TONOPAH BELMONT (Tonopah)—Stated company will exercise option on Surf Inlet mine in British Columbia on July 1, and will expend $150,000 in development work.

TONOPAH MINING (Tonopah)—Option on property of Nicaragua-Panama Mining Co. exercised and possession acquired Jan. 28. Judgment in favor of Tonopah Sewer & Drainage Co. given in suit for $1203.

WHITE CAPS (Manhattan)—Future policy of company to be decided at stockholders' meeting in Tonopah, Feb. 2. If sufficient stock be voted in favor of plan arranged with Tonopah Mining Co., that company will start investigation and sampling of White Caps immediately after meeting. Understood several propositions in regards to future operations have been tentatively submitted, should plan now under consideration by the stockholders fail to carry.

TENNESSEE

TENNESSEE COPPER (Copperhill)—Construction work resumed, according to Pres. James Phillips, Jr. New steel headframe already installed at McPherson shaft and new furnace at smelting plant; additional machinery previously specified only awaits instructions to go forward. Installation of new hoisting appliances with electrification at Burra Burra and McPherson mines at once will double hoisting facilities and enable company largely to increase ore reserve. This will mean, with good fortune in construction plans, beginning copper output of about 20,000,000 lb. annually, by Oct. 1, 1915, a 50% increase, at cost lower probably by 2c. per lb. Life of copper and sulphuric-acid ores, some of orebodies as yet hardly touched, placed at minimum of 25 years.

UTAH

Beaver County

WORK ON PLACERS near Beaver City in progress for two weeks. Good returns indicated by panning in places.

MASTER KEY (Milford)—Company organized to develop five claims formerly owned by Beaver Star Mining Co. Property adjoins Hoosier Boy.

Juab County

SALVADOR (Eureka)—Lease taken by Ferguson, McCune, and Brown, on this property owned by the Knights. Ground lies west of Beck Tunnel, produced some gold ore in past.

CHIEF CONSOLIDATED (Eureka)—Prospecting ore zone with diamond drilling by means of holes up to 200 ft. long resulted in opening of new orebody. Car of ore shipped running especially high in gold.

DRAGON CONSOLIDATED (Silver City)—Prospecting from 1900 level of Iron Blossom by means of diamond drilling in progress; first hole in 175 ft., and will probably be drilled 800 to 1000 ft. to crosscut Dragon ground.

SCOTIA (Tintic Junction)—Development being pushed at this property by Chief Consolidated Co. which has two-year lease and bond. Work to be carried to depth of several hundred ft. Ore followed on beds; about one railroad car of ore hoisted. Shipments will not be made until hauling conditions improve. It is not intention to mine smaller bunches of ore.

San Juan County

CARNOTITE CLAIM survey applied for by Thomas Kearns, formerly senator from Utah. Claims 47 in number in Dry Valley near Moab. Three different groups purchased by Mr. Kearns and associates. Some work done.

Summit County

THOR (Park City)—Control of this company's claims recently taken over by Knight interests. Ground, which is in southern part of camp, will be drained to depth of 3500 ft. by Snake Creek tunnel, which has passed through property for several hundred feet.

VIRGINIA

CRIMORA MANGANESE CORPORATION (Crimora)—Announced that modern treatment plant has been contracted for with Allis-Chalmers.

CANADA

Ontario

PORCUPINE PET—New vein cut having 6-in. pay streak of high-grade ore.

VIPOND (Schumacher)—Davidson vein opened on 300-ft. level with good results.

DOME LAKE (South Porcupine)—Mine shipped $5000 gold brick, second for the month.

McINTYRE (Schumacher)—Property examined by engineers representing John T. Milliken operating in Colorado.

PORCUPINE CROWN (Timmins)—Company will continue regular 3% quarterly dividends for coming year and will build up surplus; $212,124 was carried forward, increase of $61,551.

CANADIAN MINING CORPORATION (Cobalt)—Company, which controls Townsite, City of Cobalt and Cobalt Lake mines and old Northern Customs concentrator, installing cyanide plant to treat slimes from concentrator. Dorr apparatus will be used.

CROWN RESERVE (Cobalt)—Dividend cut from 24% a year to 12%. New rate will be paid 3% quarterly instead of 2% monthly as formerly. Mine profits for year $239,477 and revenue from investment $144,000. Surplus $771.711 against $844,615 last year. Mining profits for 1913 $528,287. Investment revenue is from Porcupine Crown of which Crown Reserve holds 60%.

The Market Report

Metal Markets

NEW YORK—Feb. 3

Copper, lead, spelter and tin have all been higher.

Copper, Tin, Lead and Zinc

Copper—Continued large buying in the early part of our week record resulted in a further advance in price, 14¾c., regular terms, being realized on Saturday. On Monday the market was firmly on that level and on Tuesday there was talk about 14⅞c. being asked, but we were unable to find that that price had been actually realized for standard deliveries; if it were the quantities involved were insignificant. Later the demand fell off very considerably, the market became rather stale and copper was available from about all quarters at 14¾c., regular terms.

The Anaconda company is going to try shipment of its blister copper from Anaconda to New York by way of Seattle and the Panama Canal, instead of by the all-rail route used heretofore. On paper, shipments in the new way figure more economically, allowing for the loss of the milling-in-transit rate from Perth Amboy to points of consumption at present enjoyed. There are, however, questions in regard to the time of copper in transit, etc., which must be determined by experience. At present, therefore, the new method is to be regarded only as an experiment.

Copper sheets were again advanced ¼c. on Jan. 29, making the base price now 19¾c. per lb. for hot rolled and 20¾c. for cold rolled. Usual extras charged and higher prices for small quantities. Copper wire is quoted at 15¾c., carload lots at mill.

Copper exports for the week ended Jan. 23 are reported by the Department of Commerce at 23,057,065 lb. The larger shipments were 11,927,323 lb. to France, 4,114,324 lb. to Italy, and 3,489,437 lb. to England. Copper imports for the week were: Metal, 1,689,614 lb.; in ore and matte, 1,583,846; total, 3,273,460 lb. The larger imports were from Cuba, Peru, Chile and Canada.

Tin—The important rise in this metal was inspired by causes that are as yet unfathomed in the trade. The statistical position does not warrant an advance in price; nor does the commercial situation generally. However, there is congestion on the docks in London, and difficulty in obtaining freight room, and there are disturbances generally which may cause important fluctuations in price here from day to day. Notwithstanding the advance this week, business was quiet and futures were quite neglected.

Lead—Some rather large sales were made at St. Louis on Jan. 28 before the A. S. & R. Co. advanced its price, or before that advance was generally known. After the advance to a basis of 3.80c., New York, business became rather dull. However, the market continued to be firm, the St. Louis price rising above the usual differential.

Spelter—The hysteric advance in the price of this metal continued up to Feb. 1, when a deadlock by exhaustion seemed to be reached. The situation is quite simple. The producers have sold out all of their stocks and all of the metal they are going to make in February, save what is reserved for regular customers and is settled for at the market. Such spelter as remains in the hands of speculators or is going to be made in February and has not been sold is insignificant in quantity. March-April spelter is still available and whatever wholesale market there may be at present is for those deliveries. Of such spelter a moderately large tonnage was sold during the last week, the reported sales during the last three days averaging about 7½c., St. Louis.

The sales that have been made by the smelters up to this time probably do not extend beyond March to any great extent. The smelters find themselves in a difficult position having to take in ores on a high level of price, and being unable to sell the expected product thereof at anything like the current price. There is, therefore, a good deal of pressure to sell April and later deliveries, which are offered at large concessions. A considerable tonnage for delivery from March to August was contracted at about 7.05c., St. Louis, while deliveries running from May to August were offered at 7c., and that price might perhaps have been shaded. However, consumers do not exhibit much interest in entering into such contracts.

If the present stringency in spelter continues, it is possible that some arbitrage business between New York and London may be done, resulting in the repurchase here of spelter that was previously sold for delivery abroad but has not yet been shipped.

The smelters in all quarters report the firing-up of furnaces that were idle at the beginning of January. There was at that time a good many cold retorts, not including what were in the moribund works in Kansas. The high level of price will, of course, draw out a large supply of ore.

The demand for high-grade, intermediate and brass special spelters continues crazy and unsatisfied. Brass special has been sold at 9½@10c. per lb., while high-grade is reported to have realized 15@17 cents.

American zinc dust, packed in 200-lb. zinc-lined cases, is quoted at 12c. per pound.

Zinc sheets were advanced during the week to 10c., then to 10½c. per lb., and were quoted today at $10.50 per 100 lb., f.o.b. La Salle, Ill. Usual extras charged.

DAILY PRICES OF METALS IN NEW YORK

Jan. Feb.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc	
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.
28	4.8507	48¾	14.30 @14.35	35¾	3.70 @3.80	3.50 @3.55	7.17½ @7.42½	7.00 @7.25
29	4.8507	48¾	14.35 @14.45	37	3.80	3.62½ @3.67½	7.30 @7.55	7.12½ @7.37½
30	4.8450	48⅝	14.40 @14.50	37¼	3.80	3.62½ @3.67½	7.42½ @7.67½	7.25 @7.50
1	4.8450	48⅝	14.55 @14.60	37¼	3.80	3.65 @3.67½	7.42½ @7.92½	7.25 @7.75
2	4.8450	48⅜	14.55 @14.60	38	3.80	3.65 @3.67½	7.42½ @7.92½	7.25 @7.75
3	4.8375	48	14.55 @14.60	37¾	3.80	3.65 @3.67½	7.42½ @7.92½	7.25 @7.75

The quotations herein are our appraisal of the markets for copper, lead, spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The difference between the price delivered and the New York cash equivalent is at present 0.15 to 0.20c. on domestic business and 0.25 to 0.37½c. on European. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Western brands. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are; St. Louis-New York, 17c.: St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c

LONDON

Jan.-Feb.	Silver	Copper				Tin		Lead		Zinc	
		Spot		3 Mos	Best Sel'td	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts per Lb.
		£ per Ton	Cts. per Lb.								
28	22⅛	62⅞	13.67	63⅛	68¾	168	157	18⅜	3.99	35	7.60
29	22⅛	63¼	13.74	63⅝	....	172	160½	18⅜	3.99	37	8.04
30	22⅛	.....	.....	.....	.....	.....	...	....	.....	.....	.....
1	22⅛	63⅝	13.82	64	....	175	162	18¾	4 07	36¾	7.98
2	22⅛	63⅞	13.88	64⅜	69½	174	161½	18⅝	4 05	37	8.04
3	22⅛	63	13.69	63½	....	173	156	18 11/16	4.06	37½	8.14

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.26¼c; £20 = 4.35c.; £30 = 6.52c.; £60 = 13.05c. Variations, £1 = 0.21¾c.

Other Metals

Aluminum remains quiet, with only moderate current business and no change in price. Current quotation is 18¾@19¼c. for No. 1 ingots, New York—**Antimony** is rather active, under demands for export, and for ammunition, with only moderate supplies. Ordinary brands are 16¾@17¼c. per lb., while 19@19½c. per lb. is named for Cookson's—**Quicksilver** is stronger, with an advancing tendency, but only moderate sales. New York price is $54 per flask, with $55 for small lots. San Francisco, $53 per flask of 7 5lb. London price is £11 10s. per flask—**Nickel** is unchanged, ordinary forms being 40@45c. per lb., according to size and terms of order. Electrolytic, 3c. higher.

Gold, Silver and Platinum

Gold—A shipment of $280,000 gold from China was received at San Francisco this week, on its way to New York. This makes a total of $3,430,000 gold received recently from China.

Platinum continues quiet and dull, with no material change, but a rather unusual range of prices. Current quotations are $38@42 per oz. for refined platinum; hard metal is quoted $45@49 per oz., according to quality.

Iridium—This metal is still rather scarce, and no general market price can be named, each transaction standing by itself.

Silver—The market has declined in New York owing to higher war insurance rates, lower London exchange and a slight depression in the London market. The selling has not been free, and the inquiry from the Indian Bazaars has been only moderate.

Silver shipments from London to the East Jan. 1 to Jan. 21, as reported by Messrs. Pixley and Abell:

	1914	1915	Changes
India	£281,000	£450,500	I. £169,500
China	10,000	.....	D. 10,000
Total	£291,000	£450,500	I. £159,500

Silver shipments from San Francisco direct to China in 1914 were $3,676,800 in value.

Zinc and Lead Ore Markets

JOPLIN, MO.—Jan. 30

Blende, high price $67.50; assay base 60% zinc, $58@65; metal base 60% zinc, $60@62; calamine base 40% zinc, $33@37; average, all grades of zinc, $60.62, an increase in one week of $12.22 per ton. Lead, high price $50.50; base price $47 per ton of 80% metal contents; average, all grades of lead, $47.48 per ton.

Approximately one-fourth of the blende shipment was from reserves, indicating a decreasing production. Sales of 1400 tons of reserve for next week's delivery are consummated. Cold weather four days and rain the latter two days cut calamine production to a minimum.

SHIPMENTS, WEEK ENDED JAN. 30

	Blende	Calamine	Lead	Values
Total this week	8,159,300	369,440	1,246,340	$288,510
Total this year	49,092,320	3,835,160	7,086,740	$1,469,860

Blende value, the week, $254,220; the month, $1,251,240.
Calamine value, the week, $4,700; the month, $52,650.
Lead value, the week, $29,590; the month, $165,970.

Iron Trade Review

NEW YORK—Feb. 3

Some improvement continues to be made in the iron and steel trades, but it is still rather slow. The mills report operations to between 50 and 60% capacity.

The most important gain reported this week is in structural steel, which for some time has been rather backward. Plates and shapes for shipbuilding show a marked gain. The demand for brass and plates is fair. Warehouse and jobbing business is reported as improving, especially in the West.

An order of 8000 tons of steel billets is to be filled by the Tennessee Coal, Iron & R.R. Co. at Ensley, Ala., to be shipped to England.

Pig iron sales show a small increase, especially in foundry iron. Stocks at furnaces are large, but are gradually working down.

PITTSBURGH—Feb. 2

The Carnegie Steel Co. has increased its output further and is this week operating at about 60% of its ingot capacity. It has reduced its pig-iron stocks by about 100,000 tons and has blown in or ordered into blast a total of 10 furnaces in the past three weeks, giving it 32 active stacks out of a total of 59. The Pittsburgh Steel Co., engaged chiefly in wire manufacture, is operating practically full, partly by reason of export trade and partly through accumulating stocks in expectation of a good spring demand. These instances are exceptional as to the extent of the increase, but all the mills are operating somewhat better than in December, and steel-mill operations in the country at large have probably reached 50% of capacity, compared with less than 35% in December.

The steel trade presents a wide variety of opinions as to the course of the market in the next few months. In some quarters it is thought the improvement is about over and that the market will have a relapse shortly, as it did a year ago after making a somewhat similar start. In other quarters an extremely gradual but continued improvement is expected. In still other quarters the belief is expressed with confidence that improvement will continue until almost normal conditions will be reached by April or May. There are rarely such divergent views expressed as is the case today.

The galvanized sheet market is almost closed, on account of the advance in spelter. Some mills remain out of the market.

Pig Iron—We quote prices unchanged: Bessemer, $13.75; basic, $12.50; No. 2 foundry, $12.75@13.25; malleable, $12.75; gray forge, $12.50@12.75, at Valley furnaces, 95c. higher delivered Pittsburgh. W. P. Snyder & Co. report their compilation of actual market sales in January at $13.6375 for bessemer and $12.50 for basic, at Valley furnaces.

Ferromanganese—There does not seem to be anything new in the situation. The nominal contract quotation remains at $68, Baltimore, while odd lots can usually be picked up at $75 or $80 per ton.

Steel—The Pittsburgh mills have lately been quoting $20 on billets and $20.50 on sheet bars, delivered Pittsburgh, but these quotations are altogether nominal since there is at least one seller at Youngstown at $18.25 for billets and $18.50 for sheet bars, with only about $1 freight into the Pittsburgh district. The consumers are all covered at lower prices. Rods are $25, Pittsburgh.

COKE

Connellsville—The market continues stagnant, consumers having no occasion to make further contracts. Prompt furnace is $1.55@1.60, and at $1.60 deliveries to Apr. 1 could easily be arranged. Foundry coke for prompt shipment is held all the way from $2 to $2.50, according to brand. The Thompson involvement at Uniontown promises to require a long time, probably years, for anything like a settlement.

Chemicals

NEW YORK—Feb. 3

The general market continues rather irregular, with sales on a moderate scale only and no special activity manifest.

Arsenic—Business has been slow and the market is a shade weaker. Quotations are $3.87½ per 100 lb. for both spot and futures.

Copper Sulphate—Business is steady and prices are firmer. Current quotations are $4.50 per 100 lb. for carload lots, and $4.75 per 100 lb. for smaller parcels.

Nitrate of Soda—Business is improving and prices are firmer, with a better tone to the market. For spot and up to October, 1.95c. per lb. is quoted, with 1.97½@2c. per lb. for later deliveries.

Potash Salts—The German government has placed an absolute embargo on exports of potash salts and manufactures thereof.

Pyrites—Imports of Spanish pyrites in the United States in 1914 were 771,665 long tons from Huelva and 82,767 tons from Pomaron; a total of 854,432 tons. This is an increase over 1913, but a decrease from 1912.

PETROLEUM

Exports of mineral oils from the United States in December were 166,858,557 gal., being 49,117,698 gal. less than in December, 1913. For the year ended Dec. 31 the total exports were 2,108,365,444 gal. in 1913, and 2,224,248,324 gal. in 1914; an increase of 115,882,880 gal., or 5.5%, last year.

The yearly statement of the "Oil City Derrick" gives new wells completed in 1914 as follows: Pennsylvania grade, 5909; Lima-Indiana, 1605; Central Ohio, 768; Kentucky, 179; Illinois, 1583; Texas-Louisiana, 1561; Mid-Continent, 10,559. The total completions were 22,164, with the remarkable new production of 1,471,652 bbl. This is the first year where the production credited to new wells passed the million mark. Of the completions 4012 were failures and 2383 were gas wells.

Assessments

Company	Delinq.	Sale	Amt.
Belcher Silver, Nev.	Feb. 8	Mar. 1	$0.10
Blue Bull, Nev.	Jan. 4	Feb. 8	0.01
Booth, Nev.	Jan. 25	Mar. 1	0.02
Brunswick Con., Nev.	Feb. 16	Mar. 9	0.01
Carbonate, Ida.	Jan. 28	Feb. 28	0.001
Cash Boy, Nev.	Jan. 15	Feb. 15	0.005
Cedar-Talisman, Utah.	Feb. 8	Mar. 1	0.005
Century, Utah.	Jan. 2	Feb. 2	0.01
Clear Grit, Ida. (post.)	Feb. 9	Mar. 3	0.0015
Clearwater Con., Ida.	.....	Feb. 15	0.001
Darby, Ida. (post)	Dec. 14	Feb. 15	0.001
Emerald, Utah (three instal.)	.....	June 9	0.01
Gethin Le Roy, Utah.	Feb. 2	Feb. 23	0.02
Gypsy Qn., Nev.	Jan. 12	Feb. 16	0.01
Idaho-Nev., Ida.	Jan. 7	Feb. 1	0.001
Indiana, Mich.	Feb. 4	.....	1.00
Iron King, Ida.	Feb. 18	Mar. 19	0.001
Keystone, Utah. (post)	Feb. 23	Mar. 23	0.02
King Pine Crk., Ida.	Feb. 12	Mar. 13	0.002
Laclede, Ida.	Jan. 12	Feb. 3	0.003
Lucky Friday, Ida.	Dec. 14	Feb. 11	0.003
MacNamara, Nev.	Jan. 12	Feb 3	0.03
Majestic-Idol, Nev.	Dec. 15	Jul. 20	0.005
Manhattan Con., Nev.	Feb. 30	Mar. 1	0.01
Nor. Bnkr. Hill, Ida.	Jan. 30	Mar. 6	0.002
Ophir, Nev.	Feb. 11	Mar. 5	0.10
Potosi, Nev.	Jan. 12	Feb. 4	0.02
Reindeer-Queen, Ida.	Feb. 15	Mar. 8	0.003
Rescue-Eula, Nev.	Feb. 11	Mar. 22	0.01
Scranton Ex., Utah.	Jan. 4	Feb. 5	0.00025
Sheba, Utah.	Jan. 12	Feb. 24	0.05
Sierra Nevada, Nev.	Feb. 8	Mar. 2	0.05
Silver Star, Ida.	Jan. 5	Feb. 5	0.002
Sunset Dev., Ida.	Jan. 18	Feb. 18	0.0025
Tarbox, Ida.	Jan. 28	Feb. 28	0.0025
Ton. Gip. Qn., Nev.	Jan. 12	Feb. 16	0.01
Umatilla, Nev.	Jan. 4	Feb. 8	0.01
Union Con., Nev.	Jan. 14	Feb. 4	0.05
Utah-United, Utah.	Feb. 20	Mar. 15	0.01
Verde May, Ida.	Feb. 1	Mar. 1	0 001

The actions of U. S. Steel common have furnished most of the interest in the stock market this last week. Following the passing of the dividend on Jan. 26, the stock sold immediately down to 48, the minimum price as established by the Stock Exchange committee and adjourned to the "gutter market," leading to successive reductions to 43, 40 and 38.

Stock Quotations

COLO. SPRINGS	Jan. 27	SALT LAKE	Feb. 1
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.04	Beck Tunnel	.07½
Cripple Cr'k Con.	‡.01½	Black Jack	.07½
C. K. & N.	.06½	Colorado Mining	.10
Doctor Jack Pot	.10	Crown Point	.01½
Elkton Con.	.49	Daly-Judge	5.00
El Paso	1.25	Gold Chain	.10
Findlay	.02½	Grand Central	.63
Gold Dollar	.04	Iron Blossom	.99
Gold Sovereign	.04½	Little Bell	.10
Isabella	.17½	Lower Mammoth	.05½
Jack Pot	‡.08	Mason Valley	1.10
Jennie Sample	.03	May Day	.14½
Jerry Johnson	.03½	Opohongo	.02
Lexington	‡.009	Prince Con.	.25
Old Gold	‡.01	Seven Troughs	.02½
Mary McKinney	.30½	Silver King Coal'n	2.80
Pharmacist	.01½	Silver King Con.	1.92½
Portland	1.17	Sioux Con.	.03
Raven B. H.	.03½	Uncle Sam	.06½
Vindicator	1.25	Yankee	.08

TORONTO	Feb. 1		
Bailey	.01½	Dome Exten.	.07
City of Cobalt	‡.30	Foley O'Brien	.14
Coniagas	5.25	Hollinger	22.50
Peterson Lake	.22	Imperial	.01
Right of Way	.01	Jupiter	.10
Seneca Superior	1.00	McIntyre	.26
T. & Hudson Bay	30.00	Pearl Lake	.03
Timiskaming	.17	Porcu. Gold	.25
Wettlaufer-Lor.	.04	Preston E. D.	.01
Big Dome	5.15	Rea	.18

SAN FRANCISCO	Feb. 1		
Comstock Stocks		Misc. Nev. & Cal	
Alta	.04	Belmont	4.00
Belcher	.28	Jim Butler	.70
Best & Belcher	.05	Lone Star	.10
Caledonia	.27	MacNamara	.03
Challenge Con.	.05	Midway	.07
Confidence	‡.10	Mont.-Tonopah	.35
Con. Virginia	.07	North Star	.16
Crown Point (Nev.)	‡.01	Rescue Eula	.07
Gould & Curry	.02	West End Con.	.52
Hale & Norcross	.03	Atlanta	.36
Julia	.01	Booth	.33
Mexican	.45	C.O.D. Con.	.06
Occidental	.84	Comb. Frac.	.07
Ophir	.06	Jumbo Extension	1.05
Overman	.10	Pitts.-Silver Peak	.14
Potosi	.02	Round Mountain	.34
Savage	.03	Sandstorm Kendall	.12
Sierra Nevada	.07	Silver Pick	.08
Union Con.	.22	Central Eureka	‡.24
Yellow Jacket	‡.28	So. Eureka	‡2.25

N. Y. EXCH.	Feb. 1	BOSTON EXCH	Feb. 1
Name of Comp.	Clg.	Name of Comp.	Clg.
Amalgamated	54½	Adventure	1
Am.Sm.&Ref.,com.	62⅝	Ahmeek	255
Am. Sm. & Ref., pf.	102½	Alaska Gold M.	28½
Am. Sm. Sec., pf. B.	80	Algomah	.50
Anaconda	27½	Allouez	41½
Batopilas Min.	⅛	Am. Zinc	20⅝
Bethlehem Steel, pf.	104	Ariz. Com., ctfs.	5
Chino	36	Bonanza	.35
Colo. Fuel & Iron.	24	Butte-Ballaklava	2
Federal M. & S., pf.	29	Butte & Superior	47½
Great Nor., ore., ctf.	30⅛	Calumet & Ariz.	53
Guggen. Exp.	51⅛	Calumet & Hecla	399
Homestake	116	Centennial	18½
Inspiration Con.	18⅛	Cliff	‡1
Mex. Petroleum	74⅛	Copper Range	33⅛
Miami Copper	18⅛	Daly West	1½
Nat'l Lead, com.	46	East Butte	9
National Lead, pf.	108	Franklin	5
Nev. Consol.	12½	Granby	63½
Ontario Min.	2	Hancock	11
Phelps Dodge	‡175	Helvetia	.25
Quicksilver, pf.	2	Indiana	2½
Ray Con.	17⅛	Island Cr'k, com.	45½
Republic I&S, com.	19⅛	Island Cr'k, pfd.	87½
Republic I&S, pf.	74½	Isle Royale	22
SlossSheffi'd, com.	23	Keweenaw	2⅛
Sloss Sheffield, pf.	‡82	Lake	6
Tennessee Copper.	30⅛	La Salle	3½
Utah Copper	53⅛	Mass.	3⅛
U. S. Steel, com.	40⅛	Mayflower	4⅛
U. S. Steel, pf.	103½	Michigan	.60
		Mohawk	53½
N. Y. CURB	Feb. 1	New Arcadian	5½
Name of Comp.	Clg.	New Idria Quick	‡3½
Beaver Con.	.26	North Butte	22⅛
Big Four	.07	North Lake	1
Blue Bell	.05	Ojibway	.50
Braden Copper	6⅛	Old Colony	4
B. C. Copper	‡.50	Old Dominion	42½
Buffalo Mines	.75	Osceola	67½
Can. Cop. Corpn.	1⅛	Quincy	52½
Can. G. & S.	.04	Santa Fe	1⅛
Caribou	.58	Shannon	4⅛
Chambers Ferland.	.13	Shattuck-Ariz.	23
Con. Ariz. Sm.	5/16	Superior	28½
Coppermines Cons.	‡1⅛	Superior & Bost.	1½
Davis-Daly	1 1/16	Tamarack	33½
Diam'field-Daisy	.08	Trinity	2⅛
Dia. Black B.	.04	Tuolumne	.23
Ely Con.	‡.01	U. S. Smelting	20½
Florence	.71	U. S. Smelt'g, pf.	39½
Goldfield Con.	1⅛	Utah Apex	2⅛
Goldfield Merger.	.28½	Utah Con.	9⅛
Greene Cananea	23½	Victoria	1½
Kerr Lake	4⅛	Winona	1⅛
La Rose	.70	Wolverine	37
McKinley-Dar-Sa.	.45	Wyandot	.50
Mines of Am.	2⅛		
Mutual Min., pf.	‡2½	BOSTON CURB	Feb. 1
Nevada Hills	.32	Name of Comp.	Bid.
New Utah Bingham	‡ 7/16	Alvarado	.70
Nipissing Mines	5⅛	Bingham Mines	‡3⅛
Ohio Copper	.09½	Boston Ely	.13
Oro	.12½	Butte & Lon'n Dev.	.36
Pacific Smelt.	7/32	Calaveras	.95
Stand'd Oil of N.J.	399	Calumet-Corbin	.18
Standard S. L.	1⅛	Chief Con.	.80
Stewart	1 7/16	Corbin	‡1
Tonopah	7⅛	Cortez	.25
Tonopah Ex.	2⅛	Crown Reserve	.65
Tonopah Merger	.39	Eagle & Blue Bell	.90
Tularosa	.25	First Nat. Cop.	1
West End Ex.	.03	Houghton Copper	1½
Yukon Gold	2⅛	Iron Cap Cop., pf.	‡5
		Majestic	.14
LONDON	Jan. 20	Mexican Metals	.15
Alaska Tre'dwell	£7 17s 6d	Nevada-Douglas	.37
Camp Bird	0 7 9	New Baltic	1½
El Oro	0 9 9	Oneco	.60
Esperanza	0 8 1½	Raven Copper	.07
Mexico Mines	4 2 6	Smokey Dev.	.10
Oroville	0 12 0	So. Lake	4½
Philippine Dr.	1 0 0	Tonopah Victor	‡.17
Santa Gert'dis.	0 11 10½	Trethewey	.13
Tomboy	1 1 10½	United Verde Ext.	1 11/16
Tough Oakes	0 11 10½		

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	.....	28.357	26.573	.....
March	57.870	58.067	.....	26.669	26.788	.....
April	59.490	58.519	.....	27.416	26.958	.....
May	60.361	58.175	.....	27.825	26.704	.....
June	58.990	56.471	.....	27.199	25.948	.....
July	58.721	54.678	.....	27.074	25.219	.....
August	59.293	54.344	.....	27.335	25.979	.....
September	60.640	53.290	.....	27.986	24.260	.....
October	60.793	50.654	.....	28.083	23.199	.....
November	58.995	49.082	.....	27.263	22.703	.....
December	57.760	49.375	.....	26.720	22.900	.....
Year	59.791	54.811	.....	27.576	25.314	.....

New York quotations cents per ounce troy, fine silver: London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York		London			
	Electrolytic		Standard		Best Selected	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	.....	65.259	.....	70.188	.....
March	14.131	.....	64. 76	.....	69.170	.....
April	14.211	.....	64.747	.....	69.313	.....
May	13.997	.....	63.182	.....	67.786	.....
June	13.603	.....	61.336	.....	66.274	.....
July	13.223	.....	60.540	.....	64.955	.....
August	*	.....	‡	.....	‡	.....
September	*	.....	‡	.....	‡	.....
October	*	.....	‡	.....	‡	.....
November	11.739	.....	53.227	.....	*	.....
December	12.801	.....	56.841	.....	*	.....
Year	13.602	.....	61.524	.....	68.168	.....

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.559
February	39.830	.....	181.556	.....
March	38.038	.....	173.619	.....
April	36.154	.....	163.963	.....
May	33.360	.....	150.702	.....
June	30.577	.....	138.321	.....
July	31.707	.....	142.517	.....
August	*	.....	‡	.....
September	32.675	.....	‡	.....
October	30.284	.....	‡	.....
November	33.304	.....	139.391	.....
December	33.601	.....	147.102	.....
Av. year	34.301	.....	156.564	.....

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	.....	3.937	.....	19.606	.....
March	3.970	.....	3.850	.....	19.651	.....
April	3.810	.....	.688	.....	18.225	.....
May	3.900	.....	3.808	.....	18.503	.....
June	3.900	.....	3.810	.....	19.411	.....
July	3.891	.....	3.738	.....	19.051	.....
August	3.875	.....	3.715	.....	‡	.....
September	3.828	.....	3.658	.....	‡	.....
October	3.528	.....	3.384	.....	‡	.....
November	3.683	.....	3.585	.....	18.500	.....
December	3.800	.....	3.662	.....	19.097	.....
Year	3.862	.....	3.737	.....	19.079	.....

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	.....	5.228	.....	21.413	.....
March	5.250	.....	5.100	.....	21.460	.....
April	5.113	.....	4.963	.....	21.569	.....
May	5.074	.....	4.924	.....	21.393	.....
June	5.000	.....	4.850	.....	21.345	.....
July	4.920	.....	4.770	.....	21.568	.....
August	5.568	.....	5.418	.....	‡	.....
September	5.380	.....	5.230	.....	‡	.....
October	4.909	.....	4.750	.....	‡	.....
November	5.112	.....	4.962	.....	25.016	.....
December	5.592	.....	5.430	.....	27.369	.....
Year	5.213	.....	5.061	.....	22.544	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported, ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.45	$13.99	$13.90
February	15.06	.....	14.12	.....	14.08	.....
March	15.07	.....	13.94	.....	14.10	.....
April	14.90	.....	13.90	.....	14.13	.....
May	14.90	.....	13.90	.....	14.27	.....
June	14.90	.....	13.90	.....	13.96	.....
July	14.90	.....	13.90	.....	13.90	.....
August	14.90	.....	13.90	.....	14.08	.....
September	14.90	.....	13.90	.....	14.03	.....
October	14.84	.....	13.75	.....	13 97	.....
November	14.59	.....	13.43	.....	13.83	.....
December	14.70	.....	13.45	.....	13.83	.....
Year	$14.88	.....	$13.78	.....	$14.01	.....

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